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CIVIL ENGINEERING.

On the Asphalted Macadamised Roads lately laid down in Paris. Compiled from the 'Annales des Ponts et Chaussées, 1850.' *By* M. De Coulaine, *Engineer of the 'Ponts et Chaussées.'**

Continued from page 302.

Application of the preceding System to Subterranean Passages, and to Cellars exposed to the Infiltration of Waters.—In the construction of railways, in the lower parts of vallies which are protected from floods by insubmersible dykes, it is often requisite to construct passages beneath the railways in such positions as are exposed to the infiltration of waters. This difficulty may be obviated by the use of a roadway with paving stones set in bitumen. The paving should be carried under the whole of the length of the bridge, and the parts of the slopes likely to be affected by the waters. To prevent lateral filtrations, the paving should be carried 4 inches under the masonry of the abutments, and a layer of asphalte, $\frac{3}{4}$-inch thick, should be formed upon the masonry of the abutments, passing through them, and extending a few inches beyond their inner face towards the land. After the masonry is carried up, this inner face should be rendered with asphalte; care being taken that the masonry be dry, and that the back rendering be made to join the horizontal layer. To insure its impermeability, it will be necessary to cover it with a coating of hot Bastenne bitumen. As soon as this operation is completed, it will be necessary also to bring the earthwork up carefully against the abutment,

* From the London Architect for April, 1851.

so as to support the rendering coat, which otherwise would sink down, owing to its elasticity. The earthwork backing must be well punned.

This horizontal paving will resist the pressure of the waters from below, so long as its weight shall exceed that required to resist the effort to raise it; should the latter be the greater, however, a modification of the system will be requisite. The following process was adopted in the execution of a passage under the railway from Tours to Nantes, at Saumur, for an occupation road:

A bed of concrete, 6 inches thick, was laid under the whole structure, so as to project beyond it 4 inches all round. When it was thoroughly dry, it was covered with a layer of asphalte about $\frac{3}{4}$-inch thick. During the whole of these works, the waters filtering through the ground were pumped away; and to render this operation more easy, drains filled-in with broken stone were formed under the concrete, and made to communicate with the wells. The coating of asphalte was then covered by a layer of masonry, about 1 foot 8 inches thick, bedded on a layer of mortar 2 inches thick, to prevent the asperities of the stones from tearing the surface of the asphalte. The abutments were then carried up, and their inner faces were rendered, as has been before described. This operation has perfectly succeeded, and the paving would at all times remain dry were it not for the rain waters. These are removed by being conducted to a well, from which they are pumped, as may be requisite.

The cellars of all the stations on the Tours and Nantes Railway, in the arrondissement of Saumur, have been protected in this manner from the waters of the Loire; and the system might be employed in many other similar positions, where the usual methods of construction would unquestionably fail.

Application to the Construction of the Vertical Sides of Basins.—Blocks of paving stone, bound together by bitumen, may be applied also to the coating of the vertical sides of basins or reservoirs, by being placed on edge. So long as the depth does not exceed 1 foot 6 inches, the usual thickness of the paving would be sufficient; when the depth is greater, they will require to be backed by masonry, as has been described for the pavements intended to resist a great effort. The coating at the bottom may be apparent, and immediately exposed to the action of the water.

The sides of reservoirs may also be executed in brickwork as follows: The bricks are to be first well brushed, to remove the dirt; they are then to be laid side by side, and parallel, the face which is intended to form the inside of the basin being upwards. They are then to be covered with mastic, without sand, and a little more liquid than usual, so that each of the bricks may be covered by a coat of not more than from $\frac{1}{8}$-inch to $\frac{1}{5}$-inch; this mastic, poured upon their faces, will necessarily flow between the bricks, and bind them together. Before the mastic has had time to cool, the bricks are to be separated from one another with a knife. The masonry is then to be executed with these bricks, faced with asphalte; bituminous mastic being used instead of mortar, so that the mastic working out from the joint may amalgamate with that upon the faces of the bricks.

The layer of mastic on the faces may be superseded by a double coat of Bastenne bitumen, laid on with the brush. But this operation, which

would unquestionably render the bricks impermeable for a time, would require to be renewed every two or three years, whilst the system above described would probably last as long as the basin itself.

When the reservoirs are very small, that is to say, from 3 feet to 6 feet wide or in diameter, and about 1 foot deep at the utmost, the bricks may be laid on edge. Beyond these dimensions, they must be used flat or endwise. When the reservoir is more than 15 feet in diameter, or more than 1 foot 8 inches deep, it will be necessary to construct the vertical walls in masonry, whose thickness will require to be in proportion to the other dimensions of the reservoir. It should then be lined with bricks set in mastic, in the following manner:

After the bricks have been covered with mastic on the face, in the manner already described, care must be taken in using them, and bonding them in courses parallel to the interior wall of the reservoir, to leave a space of about ½-inch. Then, in proportion as the courses are carried up, whether flat, edge, or endwise, according to the depth of the reservoir and the strength required for the lining, mastic must be poured into the space between them and the wall. It is essential that this operation should take place, course by course, and not at once, when all the courses are in position; no new course of bricks should be laid until the mastic is poured into the space between the lower ones, and until it is so far cooled as to have set with the wall into a solid body. Without this precaution, the lining might be blown out by the weight of the mastic. It will generally be sufficient to set the bricks on edge when there is a masonry wall built behind them.

Application for the Paving of Stables.—Stone pavings, set in bitumen, may be very successfully used in stables, for the purpose of preventing the impregnation of the soil by the urine of horses, and thus counteracting that fruitful source of miasma.

In the works executed by the French military engineers, it is usual to execute the paving in the usual way—to ram it well, so as to prevent any future settlement, to rake out the joints of the paving carefully to about 2 inches deep, and to fill them with mastic similar to that used for common footpaths. The latter operation must be performed on two separate occasions, to guarantee the mastic against too great a contraction, and to insure that the second application should be made on a surface perfectly dried, and still warm from the effect of the first.

With whatever care this process may be executed, it cannot insure the impermeability of the paving. A mastic thus prepared adheres but feebly to the paving stones; these are, to a great extent, only in juxta-position, and it is to be feared the urine must to a great extent filter between them in many points; the trampling of the horses must also aid this result. This danger might be obviated by covering the joints, at the moment of their execution, with mastic applied cold, as before described, whilst the first coat still retained some heat. But the preference decidedly should be given to the mode of paving first mentioned. The most forcible objection to the system adopted by the military engineers is, that it has been tried for roadways, and that the traffic has always destroyed them. The joints of the paving stones may also be filled-in according to any of the systems before described for the cold mastic.

Chapter XII.—Substitution of Bituminous Roadways for Street Paving in Paris, or in any other Town—and the Advantages attending its Introduction.

The amount of the circulation in the streets of Paris—at the same time that it calls for very considerable expenses, in the first place—renders the execution of the repairs of paving much more difficult and numerous; so that, in spite of the pecuniary sacrifices of the town, and the efforts of the engineers intrusted with this branch of the public service, the streets are for the most part in a very bad state. To obviate this serious difficulty, efforts have been made either to improve the street paving, or to introduce some other description of roadway, which should have greater stability, require less frequent repairs, and be always in a proper state for the circulation.

Many improved systems of paving have been tried with the hope of attaining these results. The stones have been cut with greater care, and their dimensions have been altered so as to offer less resistance to the destructive action of the traffic. The price per metre superficial has augmented, it is true, in consequence of these various ameliorations; and the advantages obtained have certainly not compensated for the increased expense. The cost of the repairs has been less in the first instance; the public has been put in possession of roads much more beautiful in appearance, and the inhabitants of the neighboring houses have been for a time relieved from some of the noise occasioned by the passing traffic. But after a certain period, even these roadways are destroyed; some stones sink, some lose their edges, a great number of the joints become so worn as to form "ruts," and at length these roads become as uneven as the others.

This result might have been foreseen, for it is the result of the natural composition of paved roads. As the stones are independent of one another, it is physically impossible that the traffic can exercise the same effect on every one of them, either from a difference in their composition, or the difference of their dimensions, and of the position of their centre of gravity, or on account of the difference in the compressibility of the ground on which they are laid. It follows, that whatever care may be exercised in the selection of the stones, whatever perfection may be attained in their dressing or mode of laying, the settlements they are exposed to cannot be the same. The edges of the stones which settle the least being no longer protected by those nearest them, are worn away. And so soon as this double effect is begun to be produced, it proceeds with great rapidity, because the shocks become greater and greater, and the edges are more and more exposed to its effects. The slightest difference of level eventually leads to this result, so that, in fact, the best description of paved roads may be said to be always in a state of unstable equilibrium. To remedy this defect in a successful manner, it would be necessary to restore every stone to its position as soon as it became displaced. This is most effectually performed by lifting the depressed stone by means of bars, and raising its bed with sand.

But this method ceases to be applicable when it is to be used in roads of great traffic, such as the streets of Paris; for, in order to be of use, it

must be constantly applied, thus interrupting the circulation in a most intolerable degree. It can, in such cases, only be applied at intervals too remote to prevent the stones from losing their shape, or from rounding on the edge. It then follows that the joints form small intervals when the stones are replaced, which continually increase, and which accelerate the production of the effect above cited. The wheels fall from one stone into the interval succeeding it, to rise again over the next stone, which they strike violently; and so on. The result is a series of shocks, whose intensity continually increases in proportion as the stones are beaten down and lose their form, and which destroys the roadway with so much the greater rapidity as the carriages are heavier and roll over with greater velocity. The lateral slip of the wheels, in the inclined parts of the roadways, augments this effect.

This want of connexion and homogeneity, in the elements of which the stone paving is composed, appears then to offer an insuperable difficulty to the attainment of a perfectly even roadway. But it is not the only disadvantage attending the use of stone in such cases. Firstly, owing to the hardness of the materials of which these roads are formed, they produce an incessant noise. Secondly, the foul waters which run down the channels cannot run away entire, but filter into the joints. And, lastly, owing to the ease with which they are displaced, paved streets offer the most suitable material for the construction of barricades in the moments of civil war. It was thus that in June, 1848, the streets of Paris were covered in a few hours with a series of citadels which cannon balls could hardly demolish. Much bloodshed would have been spared on both sides, if such materials had not existed so close to hand.

The government of the French Republic, deeply impressed with the magnitude of this danger, called the serious attention of the engineers of the Paris roads to the necessity of replacing the ancient system of stone paving by some other, which would not offer materials for the construction of barricades.

Macadamised roads would unquestionably have solved the problem; but the dust and mud they produce would be an insuperable objection in a street where the circulation is constant, as is the case in the centre of of Paris.

Wood pavings are objectionable—firstly, because they offer materials for barricades; and, secondly, because they have been found to be very costly in their maintenance, to last but a very short time, and to be excessively dangerous.

The macadamised roads in which the bituminous materials are employed, appear alone to satisfy all the conditions of the problem. In fact, the materials of which they are composed, like those of ordinary roads, are too small, and have too little consistence, to be of service in the erection of barricades. If they be considered with reference to their durability, and their adaptation to traffic, they offer every desirable guarantee, and are superior to the best description of paving, as has been demonstrated by the trial-piece near the Rue Laffitte. An objection has been raised to this system on account of its offering but little foothold to horses. The modification indicated in the previous part of this memoir (in wh ch

the macadam contains, over the whole of its surface, a mixture of flexible and resisting parts) entirely obviates this disadvantage.

It was anticipated that the bitumen would not have allowed the repairs necessary on account of any modifications of the gas or water pipes, to have been executed with sufficient ease. But we have seen that this is not the case; and that the repairs of the bitumen are as easily and as efficaciously performed as with any other description of paving.

It cannot be objected that the construction of the bituminous roadways would entail too great an expense. We have seen that the price of a metre superficial of this road, 4 centimetres thick, costs from 6·19 to 11·27 francs, whilst the ordinary street paving of Paris costs from 9 to 10 francs, and the best descriptions cost from 15 to 16 francs. M. de Coulaine expresses a very strong conviction that the method of constructing the bituminous roads, whose cost will not exceed 6·19 francs per metre, if combined with the system of repairing with materials applied cold, will give the most satisfactory results. There then appears every reason to believe, that so far from being the source of greater outlay, the new description of road will be the means of introducing a very considerable economy.

As to the cost of maintenance, the comparison made between the portions of the bridge of Saumur, executed in bituminous macadam, and those in common paving, justifies the anticipation that on this score also there will be a considerable economy. Even should this not be the case, these roads would still possess the great advantage of retaining much longer their state of perfect viability.

The principal advantages of the kind of road under consideration may be thus resumed:—

1st, They possess greater stability than any other kind of road in use, and do not require for their repairs those general operations which interfere so seriously with the circulation.

2d, They are constantly even, without being slippery, and are softer than the best macadamised roads.

3d, They obviate the noise of paved, or even of the best macadamised roads.

4th, They do not offer the materials for the formation of barricades.

5th, They guarantee the subjacent soil from all humidity.

6th, They dispense with the necessity for rendering an arch, if applied immediately upon it.

7th, They wear away very slowly, and, consequently, do not occasion much dust, or mud, thus obviating one of the great disadvantages attending the introduction of macadamised roads into the interior of towns.

8th, M. de Coulaine adds—(what seems more than hypothetical)—a further advantage, viz., that they are likely to be more favorable than any other kind of roadway to the application of steam for ordinary locomotive purposes, on account of their greater regularity and evenness, and of the absence of dust.

(*Note by the Translator.*)

Some liberties have been taken with the literal text of the original document written by M. de Coulaine; but the meaning has been as care-

fully rendered as the idioms of the two languages appeared to admit. The principal object proposed in the slight changes introduced, has been the condensation of the perhaps too diffuse essay contained in "*Les Annales des Ponts et Chaussées.*"

The translator would also beg to guard against the impression that he participates the enthusiastic confidence of the author in the perfect success of the modifications in the employment of the macadamised bituminous roads. He has known the results of the specimen at the end of la Rue Laffitte to be satisfactory; and that the traffic of eight years has but little affected it. But the macadamisation of the Boulevard has been too recently executed to allow of its being cited in any way beyond that of producing roads perfectly noiseless, and of very remarkable easiness of draft in summer. The system of street sweeping in Paris is far better organized than our own; but still it would appear that in the wet season, the Boulevards are inconveniently muddy. The expense of the maintenance also remains to be ascertained.

Enough, however, has already been proved of the advantages of the asphaltic roads to warrant our assertion of their superiority to any others in use where the absence of noise is a desideratum. In many of the London squares, near churches, hospitals, and places of public meeting, such roads are preferable to all others, if properly constructed. There does not appear to be any reason to doubt but that if they be properly swept, they would be as clean and as economical as any others.

Unfortunately, English engineers rarely pay sufficient attention to the practical details of their works, to allow us to hope that the delicate operations—almost chemical—required for the success of these roads, should be properly executed. Until the results shall have been, therefore, indisputably ascertained abroad, we must despair of seeing any serious attempts for their introduction into this metropolis, to the wants of which they appear to be admirably adapted in many cases.

On the Construction of Iron Vessels exposed to severe Strain. By William Fairbairn, F. R. S.*

In the construction of vessels—such as pipes, boilers, &c.—exposed to severe internal pressure, it is desirable we should have some knowledge of the strength and condition of the material used, and some fixed rule calculated to enable us to judge with accuracy as to the disposition of the parts, in order to apply the greatest strength in the direction of the greatest strain; and, in fact, so to dispose of the material, that every part of a vessel shall balance itself in its powers of resistance when subjected to uniform pressure.

To attain these objects, the author gave the results of his experiments on iron plates, first announced to the British Association, and subsequently published in the Transactions of the Royal Society. These experiments were originally undertaken to determine the strength of metal plates, beams, and angle-iron, as applied to ship building; and they have since been continued, from time to time, to determine the equally important nature of the construction of malleable iron bridges, boilers, and other

* From the London Architect for August, 1851.

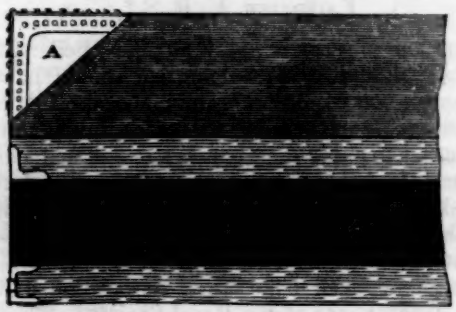
vessels, such as caissons and malleable iron pipes, which are now beginning to be extensively used for pump-trees, and other articles connected with mining.

To attain satisfactory data on the strength of iron plates, they were submitted to direct experiment—first, by tearing them asunder in the direction of the fibre, and afterwards across it; the tensile strength per square inch was as follows:—

	In the direction of the fibre.	Across the fibre.
Yorkshire plates,	=24·26	26·63
Derbyshire, "	=21·68	18·65
Shropshire, "	=22·82	22·00
Staffordshire,"	=19·56	21·01
Mean,	22·16 tons.	22·29 tons.

From this it will be observed there is no difference in the tensile strength of iron plates, whether torn in the direction of the fibre or across it; and that probably arises from the superior manner in which that article is now manufactured.

These experiments would, however, be imperfect as regards construction, if they had not been extended to the process of riveting, and on this point our information is of the most meagre description. Until of late years, many of our numerous constructions have been conducted under the impression that the riveted joint was not only strong, but stronger than the plate itself; whereas, more than one-third of the strength is lost by that process. Confirmatory of these views, it may be stated, that it was found by direct experiment that the strength of iron plates as compared with their riveted joints was as 100 : 70 for the double riveted joint, thus ; and as 100 : 56 for the single riveted joint, thus ; evidently showing a considerable diminution in the strength of those parts where the union of the plates is effected.



From the above data, practical formula was deduced, showing that the maximum resistance of riveted plates does not exceed 27,000 lbs. to the square inch; but, taking into account the crossing of the joints, and the adhesion of the two surfaces in contact, 34,000 lbs., or 15 tons, was

found to be the ultimate powers of resistance of sheet iron plates, when riveted together similar to those in boilers and other constructions.

Mr. Fairbairn then exhibited sketches and diagrams in illustration of boilers of the cylindrical form, showing the necessity for adherence to form, and all those elements in construction so essentially requisite for the attainment of uniformity in the strength of all the parts. For these objects, gussets, similar to those adopted for giving stiffness and rigidity to the Britannia and Conway tubes, were in this case recommended, as shown in engraving, for imparting strength and retaining the flat ends of cylindrical boilers in shape.

The gussets which are shown at A, would diverge or radiate from the centre of the boiler, and might be increased in number according to the pressure the boiler was calculated to sustain; or, rather, equal to the strength of the other parts of the structure. The author earnestly recommended this principle of construction, as infinitely superior to stay-rods as a means of security against sudden and unexpected pressure.

Steam Brake for Locomotive Engines. By G. Maugham, C. E.*

The system of brake in question consists in fixing to the support or other convenient part of the boiler, a steam cylinder or valve *a*, from 6 to 8 inches in diameter; the piston or valve rod being connected with the ends of the levers *b b*, which act upon the blocks *c c*, constituting the break. A connexion is formed with the boiler, by means of a small steam pipe *e*, having a shut off cock fixed within reach of the engine driver.

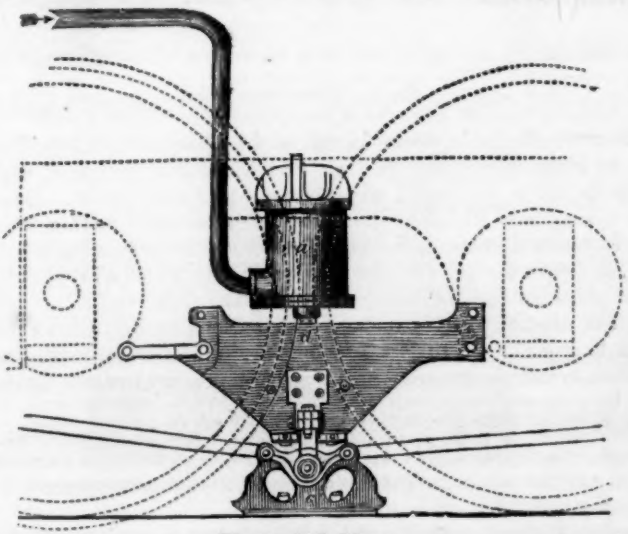


Fig. 1.—Side View.

The steam being admitted under the piston, raises the same, and consequently the two levers *b b*, and thus cause the brake-blocks *c c*, to

* From the London Architect for September, 1851.

descend upon the rails. The pressure of the steam gradually increases, until it has acquired the same force as that in the boiler. The pressure on the rails will then depend upon the force of steam per square inch in the cylinder or valve, multiplied by the leverage. The communication with the boiler being shut off, and the discharge cock opened, the brake-blocks will rise by means of the counterweight fixed on the levers. The effect of this break may be regulated at pleasure, by admitting more or less steam, as circumstances may require.

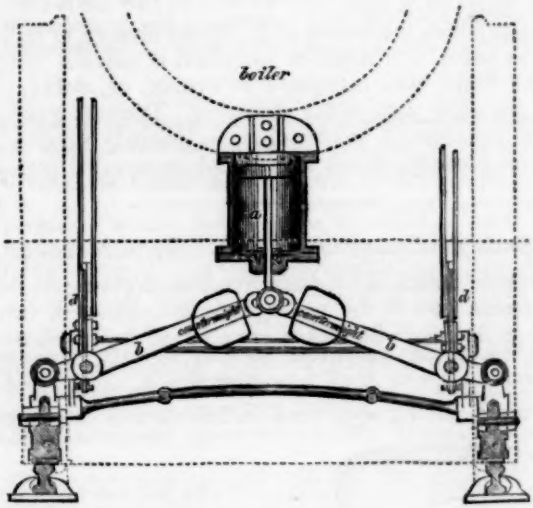


Fig. 2.—Transverse Section.

The above brake has been in use on the Namur and Liege Company's lines in Belgium during the last fifteen months, and daily experience proves its use to be highly advantageous and economical. The advantages arising from its application may be enumerated as follows:

1. In cases of immediate danger, the brake in question acts instantaneously, it being worked by the engine driver, who is in most cases the first to perceive the necessity of stopping the train.

2. The elasticity of the steam acting like a spring, allows the brake-blocks to rise over the inequalities of the line in passing over bad joints, switches, crossings, &c.; whence a great superiority over the brakes acted upon by a screw.

Lastly, its economy. By applying a steam-brake to locomotives, a brake carriage and its attendant may be dispensed with; thus decreasing the current expenses, viz: constant repairs to wheel tyres, guard's wages, to say nothing of the traction of the carriage.

The cost of a steam-brake (each) applied to a goods engine, is about 25*l.*; to keep the same in repair the cost is insignificant, the plates under the brake-blocks being the only pieces which require replacing from time to time.

Tender-wheels under the system usually adopted are very soon worn out, and require re-tyreing; by affixing a steam-brake to the engine, no necessity exists in ordinary cases to allow the tender wheels to slide or skid upon the rails in stopping a train. In order to test the value of the above system, an experiment was made on the Mons and Manage Railway, on an incline of 1 in 100, its length being about 2½ miles. To regulate the descent of a train of 42 loaded wagons, a single brake-carriage and the steam-brake were only made use of; whilst by the ordinary method, the same train required two brake-carriages and the tender brake. In the latter case, 14 wheels were exposed to rapid wear and tear, whilst in the former only 4 wheels were allowed to skid along the rails.

The above experiment fully bears out what has hitherto been stated, as far as regards the economy of the system. The utility of a brake of this description, in cases of extreme danger, cannot be questioned. Its extended application to locomotive engines would be a great safeguard to the public, and might probably be the means of preventing the recurrence of accidents similar to those which have recently taken place in England.

Mons, Belgium, July, 1851.

AMERICAN PATENTS.

List of American Patents which issued from October 14, *to November* 4, 1851, (*inclusive,*) *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

16. For an *Improvement in Insulators for Telegraph Wires;* John M. Batchelder, Cambridge, Massachusetts, October 14.

"The object and design of this invention is, to afford a convenient and suitable holder or supporter for the wires of the electro-magnetic telegraph, and to secure a more perfect insulation of the wires, especially during rain-storms, than has heretofore been effected."

Claim.—"What I claim is, the re-entering angle at or near the base of the cup, as described, for the purpose of giving the wind a direction downwards, thereby preventing the rain that is driven by the wind, from entering the cavity of the cup.

"I also claim the annular disk, or washer, supported upon the centre shank, or rod, and so placed within or at the open or lower end of the inverted cup, as to prevent the free access of wind and rain to the inside of the cup.

"I do not claim the mode of imbedding the shank in glass, cast around it; but I do claim the application of the enamel, or glazing of porcelain, glass, or other vitrified non-conducting material, to a surface of metal, when the same is used for insulating the wires of the electric telegraph."

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17. For an *Improvement in Insulators for Telegraph Wires;* Zenas C. Robbins, Washington, District of Columbia, October 14.

Claim.—"What I claim as my invention is, my improved insulating supporter for telegraph wires, composed of the supporting and protecting cover, the winged tube, the wire holder, and the insulating segments, arranged and combined with each other, substantially in the manner herein represented and described."

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18. For an *Improvement in Imitating Marble;* Hiram Tucker, Cambridge, Massachusetts, October 14.

Claim.—"What I claim as my invention is, the process, substantially as described, of preparing and applying colors to glass, or other suitable transparent medium, so as to imitate the varied or colored appearance of polished marble or other mineral."

19. For an *Improvement in Shower Baths;* Wm. H. Brown, Worcester, Massachusetts, October 14.

Claim.—"What I claim as my invention is, the manner of hitching and unhitching the bath, for the purpose of suspending it when raised, and lowering it when desired, by means of the hooks, in combination with the looped strap, carrying a pulley, arranged and operating in connexion with another pulley, substantially as shown and described."

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20. For an *Improvement in a Machine for Cutting Corks;* George Hammer, Philadelphia, Pennsylvania, October 14.

Claim.—"Having thus fully described my improved cork cutting machine, what I claim therein as new is, the cylindrical crown cutters, substantially as herein described, formed of an adjustable cylindrical smooth knife, surrounded by a burr cutter, the relative positions being adjustable, and the two being separable for sharpening, as fully set forth in the above description."

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21. For an *Improvement in Machines for Twisting Fringes of Shawls, &c.;* John Nesmith, Lowell, and Wesley Sawyer, Dracut, Massachusetts, October 14.

Claim.—"We do not wish to limit ourselves to the special construction and arrangement of parts herein specified, as these may be variously modified within the range of our invention, by the mere substitution of mechanical equivalents; but what we do claim as our invention is, the method of selecting from the mass, the threads which are to be twisted into separate strands, by means of a reciprocating or vibratory finger, or the equivalent thereof, substantially as described, in combination with the first shell and wheel, or their equivalents, substantially as described, for giving the twist to the strands as described.

"We also claim, in combination with the first twister, the employment of the finger or fingers, or the equivalent thereof, for selecting and drawing together the strands which are to be twisted together to form the fringe as described; and in combination therewith, we also claim the second twisting wheel and shell, or their equivalent, substantially as described."

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22. For an *Improvement in Grinding Mills;* William Newlove, Utica, New York, October 14.

"The nature of my invention consists in conducting the material to be ground, directly from the crushing rollers, by means of openings through these two grinding cones B and C, into a cavity in the smaller end of the inner revolving cone B, and from thence, causing the same to be distributed through the same openings between the said outer and inner grinding cones, B and C, where it is ground to the required degree of fineness."

Claim.—"I do not claim the original invention of the crushing cylinders, nor of a conical cast-iron mill for grinding substances; but what I do claim as my invention is, the mode and manner of feeding the material to be ground, directly from the crushing cylinders, through the opening in the outer cone C, into the cavity in cone B, through the four openings therein, as they pass, in turn, under the opening in C aforesaid, and thence through the same openings out of said cavity, between the two grinding cylinders B and C, and also the mode and manner of making the said openings, by the introvenient points *e, e, e, e.*

"And I also claim the arrangement of the teeth of the outer cone C, into two sets, the first section at the smaller end, being large and coarse, and turned so as to cut against the edges of the corresponding teeth of cone B, while the other section of teeth, or those towards the larger end, are finer, and turned in the opposite direction, so that their backs, and not their edges, are cut and ground upon, by the edges of the corresponding teeth of cone B."

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23. For an *Improved Door Lock;* Chas H. Beatty, Wheeling, Virginia, October 14.

Claim.—"What I claim as my invention is, the combination, in the same lock, of the bolts provided with two sets of diagonal slats, or their equivalents; the slide running at right angles thereto, having pins, or their equivalents, and two key notches; and the drops

acting as described, by which I make a right and left hand lock, which must be locked before the key can be withdrawn, and which forces the operator to turn the key in a certain, but different direction, according as either edge of the lock is uppermost."

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24. For *Improvements in Machines for Making Nuts, Washers, &c.;* William Kenyon, Assignor to Joseph P. Haigh, Andrew Hartupee, and John Morrow, Steubenville, Ohio, October 14.

Claim.—"What I claim as my invention is, the compressing and discharging the nut, or washer, by means of the follower, or hollow piston, the bracket, the cross-head, and the moving die-box, constructed and operating substantially as described."

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25. For an *Improvement in Axle-boxes for Railroad Cars;* Robert Levington, Monroe, Michigan, October 14.

Claim.—"Having thus fully described my improved oil box, what I claim therein as new is, the sliding partition operated upon by a screw, or its equivalent, in combination with the inclined bottom, at the inner end of the packing space, condensing the packing more at the inner end of the packing space than at the partition, whereby the oil is prevented from escaping, as well as insuring a constant supply of oil to the journal, substantially as herein set forth."

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26. For an *Improvement in Water Wheels;* James L. Parker, Shirley Village, Massachusetts, October 14.

Claim.—"What I claim as my improvement is, the combination of the curved partition *d*, and the air space or passage *p*, with each two buckets, and for the purpose of causing the escape of air from the bucket into the next one in rear, all substantially as specified."

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27. For an *Improvement in Overshot Water Wheels;* Edmund Sheetz, Campbellstown, Pennsylvania, October 14.

"The nature of my invention and improvement consists in the attachment of a self-acting gate to each bucket of an overshot wheel, for the purpose of retaining the water in the bucket until it is carried to the lower part of the wheel, and thereby increasing the power and motion of the wheel."

Claim.—"What I claim as my invention are, the self-acting gates, attached to the buckets of an overshot water-wheel, in the manner described and for the purposes herein set forth."

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28. For an *Improved Padlock;* Thomas Slaight, Newark, New Jersey, October 14.

"The nature of my improved lock is the combination of the tumblers, bolt, and springs, in such a way as to cause the springs to perform their offices, to sustain both the tumblers and bolt in place, and carry them forward when drawn back by the key in unlocking, and to throw the shackle out when unlocked, and permit it to lock again without a key; the tumblers acting as counter bolts, to prevent the catch from being thrown open by a blow, or picked, moving with the bolt to which they are attached."

Claim.—"Having thus fully described my improved padlock and its mode of operation, what I claim therein as new is, the arrangement of the bolt, tumblers, and springs, as herein set forth; the tumblers and bolt being operated by the same springs, which also serve the purpose of throwing out the shackle, the tumblers projecting beyond the end of the bolt for that purpose, all substantially as herein described."

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29. For an *Improvement in Stoves;* Elisha Vance, Cincinnati, Ohio, October 14.

Claim.—"Having thus fully, clearly, and exactly described the nature, construction, and operation of my invention and improvements in stoves, what I claim therein as new is, making, as described, a space between the fire-place and the back oven the terminus of all the flues, and causing the vertical flue between the ovens to be an ascending or descending flue, by means of the register damper, as described.

"And I furthermore claim the combination of the first with the second feature, for the purpose and in the manner described."

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30. For *Improvements in Lamps for Burning Vapor of Benzole, &c.;* Chapman Warner, Washington, District of Columbia, October 14.

Claim.—"What I claim as my invention is, the generator and lamp herein described, consisting essentially of chambers, long and narrow at their lower extremities, and fitted with pipes, or their equivalents, for the introduction of air; the said chambers communicating at their upper extremities, with a common reservoir, or vapor space, or chest, in which the vapors from the chambers are mingled, prior to burning, and the relative volumes of the inflammable vapors being regulated by the adjustment of the respective currents of air, whereby the regular proportionate and economical consumption of the fluids is ensured, and an equable light of the requisite intensity and volume is maintained, substantially as herein set forth."

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31. For an *Improved Furnace Employed in Welding Shanks to Tools;* Jonathan White, Antrim, New Hampshire, October 14.

Claim.—"Having thus described my improvements, I shall state my claim as follows: what I claim as my invention is, the combination of the groove formed in the brick work above the fire, with the aperture *h*, *h*, leading thereto, and the reverberatory channel and exit flue leading therefrom, arranged with reference to each other and the fire, substantially in the manner described, whereby the flames, gases, &c., are caused to act upon both sides of such portions of the blade and shank as are to be welded to each other, and the other portions of the blade are protected from the heat, substantially as described."

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32. For an *Improvement in Air Heating Stoves;* Gordon Williston, Charlestown, Massachusetts, October 14.

Claim.—"What I claim as my invention is as follows: that is to say, I claim the air space, the curved chamber, the series of descending pipes, and the ascending pipe, in combination with the air space, the chamber of combustion, and ash pit or chamber, all essentially in manner as specified."

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33. For an *Improvement in Solar Lamps for Burning Lard or Oils;* John G. Webb, Williamsburgh, New York, October 14.

Claim.—"Having thus described my invention, I do not claim either the use or construction of the deflector, button, or any part of the lamp separately considered; but what I do claim as my invention is, the combination of the stationary or an adjustable button, with a deflector of metal, placed above the base of the flame, attached to any lamp constructed with an argand burner, for consuming lard, or crude oil, substantially arranged as set forth in the foregoing specification."

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34. For an *Improvement in Argand Gas Burners;* John G. Webb, Williamsburg, New York, October 14.

"I am aware that a burner has been patented, covering a long expansive chamber, to contain the gas to be burnt; but in my burner the ordinary argand burner is used, which is public property; and the patent before referred to, covers a bell shaped mouth, formed by the lower end of the gas chamber, or burner; but in my improvement, no such bell shaped mouth is used, and I use a cone, which I am not aware has ever been used with any other argand hydrogen gas burner; and although a cone has been used with a circular wick burner, it will be seen that the argand carburetted hydrogen gas burner is entirely different, both in the material burnt, and in the construction of the parts."

Claim.—"Therefore, I do not mean to limit myself to the precise shape of the yoke, or to the proportions or size of the parts, as these must be varied according to the amount of draft required for different qualities of hydrogen gas; neither do I mean to limit myself to the shape of the burner, as long as the argand principle of the inner and outer draft is maintained; and though I described the cone as contracted at the base of the burner

and slightly larger near the flame, as the best arrangement I have found in practice, yet some qualities of carburetted hydrogen gas, or a difference of pressure in the supply, may require the cone to be parallel to the top or contracted at the top; I therefore do not limit myself to the exact form shown at the top of the cone, because the variations thus stated are merely practical and contingent, while the main features of the application described remain substantially the same as set forth.

"I therefore claim the construction and use of an argand burner and button, with a cone, to regulate a supply of air to the base of the flame, in combination with an outside draft between the cone, and a suitable glass chimney, to complete the combustion, and turn the flame over the button; such parts being applied to burning carburetted hydrogen, or similar gas, substantially as described and shown."

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35. For an *Improvement in Insulators for Telegraphs;* John Yandell, St. Louis, Missouri, October 14.

Claim.—"What I claim as my invention is, casting the glass insulators of magnetic telegraph and other wires, of a cylindrical form, with a flanch at one end, eccentric with the periphery of the same, its upper part being even with the top, and its lower part dropped slightly below the cylinder, and forming the bore of the cylinder, likewise eccentric with the periphery, so as to allow a greater body of glass to form at its lower part than at its upper part, where it is slit from its outer to its inner periphery, to allow the insertion of the wire, and inserting the insulator so formed into a horizontal hole, into which the wire is previously introduced through a slit at its side, bored through the post, or through a bracket secured on its side, or to a tree, and corresponding with the form of the flanch, which fits therein in such a manner as to insulate the wire from contact with the post, and prevent the glass from slipping round, and consequently the escape of the wire from the glass, as herein described, or in any other form substantially the same as the form and modifications above described."

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36. For an *Improvement in Burglar Alarms;* John G. Bolen, City of New York, October 21.

Claim.—"My claims in the above described invention, I shall confine to a group or train of barrels, or firing chambers, in combination with the pierced fuse and vent holes, constructed, prepared, and operated essentially in the manner and for the purposes above set forth and described."

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37. For an *Improvement in the Tops of Cans or Canisters;* Alfred Bliss, Newark, New Jersey, October 21.

Claim.—"Having thus fully described my invention, and the advantages thereof, what I claim therein as new is, the swaging or striking up the collar to receive the cover on the conical frustum, in place of soldering a separate one on, as heretofore."

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38. For an *Improvement in Air Heating Stoves;* Charles A. Bogert, West Dresden, New York, October 21.

Claim.—"What I claim as my invention is, the combination of a revolving cylinder or cylinders with a fire grate, to form a heating apparatus, as above described."

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39. For an *Improvement in Ship's Winches;* Thomas G. Boone, Brooklyn, New York, October 21.

"The nature of my invention consists in the investing of the power of the lowering motion of one load or burden, so as to make it aid in the hoisting of another; thereby greatly facilitating the loading and unloading of shipping, making the labor easier and the despatch greater."

Claim.—"Having described my invention, its mode of construction and operation, I do not claim the rigging of a winch or windlass with counter-falls, for the hoisting and lowering of burdens on the counterpoise principle, at whatever relative distance of hoisting and lowering it may be fixed, simply as such.

"But I claim the combination in a ship's winch, of the principle of adjustability with

the principle of counterpoise; whereby I am enabled to vary the relative distances of the hoisting to that of the lowering motion, so as to adapt its action to various changes of the relative distances of the hoisting to that of the lowering, as required in the lading and unlading of vessels.

"I claim also therewith, the principle of using a hoisting in connexion with a lowering fall, so that the burden is hoisted by one fall, and lowered by the other, instead of interchanging the falls; so that each load or parcel is both raised and lowered by the same fall, as has been practised in other counterpoise machines; by which means my winch is more convenient to use than it would otherwise be, when the hoisting and lowering distances are dissimilar.

"2d, I claim a fall, or chain and hook, suspended over the deck or scaffold, working as a suspension chain and medium of transfer from the hoisting to the lowering fall of a ship's winch, whereby I am enabled, as described, to transfer packages or burdens, in sling, from the hoisting to the lowering fall, without re-slinging or otherwise resting them."

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40. For an *Improved Ore Washer;* Arnold Buffum, Brooklyn, New York, October 21.

Claim.—"What I claim as my invention is, the combining in the same separating cistern, the spiral channel, having a discharge aperture at the centre, and the revolving dasher, whose arms are immediately above the channel, for the purpose of separating metals from the impurities with which they are mechanically mixed, by acting in the manner substantially as described.

"And I claim this construction, irrespective of the use of quicksilver in the channel, which may in some cases be dispensed with."

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41. For *Improvements in Dressing Cotton Duck;* Horatio N. Gambrill, Baltimore, Maryland, October 21.

"The nature of my invention consists in subjecting the canvass to a jet or jets of steam, and passing it over, under, or around stationary heated cylinders, or friction rollers, and between and around rotary pressure calender rollers, while the canvass is in a state of tension."

Claim.—"Having thus fully described my invention, what I claim therein as new is, the process herein described, of softening and stretching cotton duck, by subjecting it, whilst strained, to jets of steam, and passing it over, under, or around heated stationary friction rollers, and between and around rotary pressing calender rollers, for the purpose herein specially set forth and described."

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42. For an *Improvement in Printing Presses;* John R. Hathaway and John P. Strippel, Norfolk, Virginia, October 21.

Claim.—"What we claim as our invention is, arranging upon a horizontally reciprocating carriage, a blanket frame, pressing cylinder, set of inking rollers, and sheet flyer, in such a manner that the two ends of the pressing cylinder shall roll upon the side rails; thus constituting a pair of the carrying wheels of the carriage, and producing a rotary motion of the pressing cylinder, as it passes over the type form, and whereby the requisite motion is given to the blanket; the several parts being constructed and arranged substantially in the manner and for the purposes herein set forth."

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43. For an *Improvement in Washing Apparatus;* James T. King, Baltimore, Maryland, October 21.

Claim.—"Having thus fully described my invention, what I claim therein as new is, the application of boiler *h*, with or without divisions, placed over the revolving boiler, resting on frame *i*, the bottom of which boiler forms the upper half of the flue *m*, by which both boilers are heated by the same fire, and from which the revolving boiler may be supplied with water, as herein fully described and represented."

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44. For an *Improvement in Apparatus for Regulating the Speed of Engines;* H. A. Luttgens, City of New York, October 21.

Claim.—"What I claim as my invention is, governing the throw of the variable cut-off

eccentric, for the purpose of operating the cut-off, so as to regulate or equalize the speed and power of the engine, by means of the balance of or difference between the constant friction produced by the revolution of a pulley, which is hung loosely upon the same shaft with the said eccentric, and driven at a speed which always bears the same proportion to, but is greater than the speed of the shaft, and the variable friction of a brake shaft upon a wheel, which is also hung loosely upon the same shaft, and which receives or is acted upon by the aforesaid constant friction of the pulley, the lightness of the brake strap and the friction produced by it, being controlled by a common steam engine governor; the whole operating substantially as described; the said balance or difference of friction producing either an uniformity or difference between the speed of the shaft and of the wheel, and the said difference in speed causing motion to be given to any train of mechanism, substantially such as is described, in communication with the eccentric."

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45. For an *Improvement in Machinery for Enamelling Mouldings, &c.;* Robert Marcher, Cornwall, New York, October 21.

Claim.—"What I claim as my own invention is, the arrangement of the conveyer, constructed so as to form, in connexion with the moulding or the article to be enamelled, a reservoir to contain the composition, said moulding forming, as it were, a sliding bottom to the reservoir, by which means the composition is spread upon its surface, as set forth.

"I claim also the clamp for fastening and releasing the end of the article to be enamelled; the whole being constructed and operating substantially in the manner and for the purpose described herein."

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46. For an *Improvement in the Mouth-piece for Wind Instruments;* Charles L. Meech, Preston, Connecticut, October 21.

"The nature of my invention consists in making a mouth-piece of the form commonly used, with the exception of a flanch or rim fitted to the outside of the upper part of the cup, and attaching thereto an artificial embouchure or lips, which, by blowing against, vibrates and sounds the instruments with great ease and effect."

Claim.—"What I claim as my invention is, a mouth-piece, with an artificial embouchure or lips attached to it, using for that purpose any elastic and water proof material which will produce the intended effect."

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47. For an *Improvement in Sugar Vacuum Pans;* James M. Miller, City of New York, October 21.

"My improvements consist in the mode of constructing steam pipes for sugar pans, and in their arrangement and combination with said pans, and with the boiler that supplies them with steam; by which arrangement the steam is conducted by the shortest possible course through pipes to every part of the pan, and the condensed steam or water has a free and direct course back into the boiler."

Claim.—"Having thus fully described my improved apparatus and its purposes, I claim as my invention, 1st, The evaporating and condensing tubes, constructed and arranged in the manner and for the purpose set forth; they being attached at one point only, through which the steam enters, have freedom to expand or contract without injury; and the evaporating tubes being combined at the centre of the series, as above specially set forth, with the boiler, the steam is conveyed from the boiler to the extremities of all the tubes in the most direct manner.

"I also claim connecting the filters with the vacuum pan, in the manner and for the purpose set forth, so that the vacuum pan shall perform the double office of making the vacuum in the filter and boiling in vacuo.

"I also claim the construction and arrangement of the condenser tubes above specified, the ends of said tubes being turned back inward nearly the whole length of the outer portion, as distinctly shown in the drawing."

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48. For an *Improvement in Running Gear of Railroad Cars;* William Nebinger, Sharpsburgh, Maryland, October 21.

"The peculiar characteristic of this improvement is in the construction and combination of a jointed perch or vibratory beam, placed on pivots at the centre of each truck, which combination constitutes a director of all the trucks in the train, on their reaching the

curved portion of the track passed over by the truck under the locomotive; this perch beam is connected with, but not united to the other set of trucks, all working on a pivot journal in the same manner as the first set, and operated on by a suspended globe joint, admitting of a horizontal and slight vertical movement."

Claim.—"What I claim as my invention is, the employment of the bar B B, and ball and socket joint D E, attached to the ends of B B with a hinge, in combination with the pivot *c*, on the truck frame, for directing and turning said frames, (but not drawing the train by said ball and socket joint, as I do not dispense with the ordinary traction or coupling bar H,) and thus bring the axis of each truck coincident with the radii of the curve of the track, and lead the whole train over any point on the track previously passed by the locomotive, without requiring the action or aid of the flanches, or any of the wheels, except those on the locomotive; thus preventing the abrasion or wear of the rails, and liability of the train being thrown off."

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49. For an *Improvement in Piano Forte Strings;* Henry J. Newton, City of New York, October 21.

"My invention consists simply in coating the smaller strings of pianos with silver, in any of the usual ways, for the purpose of improving the tone; at the same time protecting them from the rusting action of the atmosphere."

Claim.—"I do not claim as my invention simply the application of silver to the strings of pianos, for the purpose stated, as that has before been done by wrapping the strings with silver wire; but when wrapped with wire, are liable to rattle when struck with the hammers: but what I do claim as my invention is, coating the smaller strings of pianos with silver, or an alloy thereof, for the purpose of improving the tone, and preventing the rusting of the strings, substantially as specified."

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50. For an *Improvement in Excavating Machines;* Benjamin W. Remy, Brookville, Indiana, October 21.

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, the within described arrangement of parts, by which the elevators can be raised or lowered, to correspond with any irregularity or unevenness of ground.

"And I also claim making the operation of dumping self-operating, by means of the friction roller acting on the periphery of a pulley, permanently attached to the shaft, as herein fully described and represented, and for the purpose made known."

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51. For an *Improvement in Saddles;* John C. fr. Salomon, Cincinnati, Ohio, October 21.

"The nature of my invention consists in constructing saddles with pads, connected by hinges to a frame, to which, by means of a spring and levers, acting as springs, the seat is attached."

Claim.—"What I claim as my invention is, the combination of levers and spring, as set forth in the specification and drawings."

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52. For an *Improvement in Cast Iron Car Wheels;* Benjamin Severson, Schenectady, New York, October 21.

"The nature of my invention consists in having a solid hub and chilled rim, united by a single web or plate, so curved as to give an abundance of compensation for the contraction of itself and of the hub in cooling, after the rim shall have become nearly fixed, in consequence of being chilled; and also with a comparatively small amount of metal, to give the wheel all the required strength, either in a vertical or in a lateral direction."

Claim.—"I do not claim the chilled rim, the solid hub, or the single plate, with corrugations; nor do I claim simply radial corrugations: but what I do claim as my invention in the shape of cast iron wheels, is, the forming of said wheels with corrugations in the direction of the radii, which corrugations are reversed in passing from the hub to the rim, so that the parts convex at the hub, in passing towards the rim, gradually lessen their convexity, and then become concave, and increase in their concavity till they reach the rim; and so that on the other hand, the parts concave at the hub, in passing towards the rim, gradually lessen their concavity, and then become convex, and increase in their convexity till they reach the rim; the arches or central lines of the corrugations thus cutting obliquely,

and passing through, alternately from one side and from the other, a plane supposed to be at right angles to the axis of the wheel, and to pass through the middle of the hub; and the said corrugations in their radial direction being either straight or curved; the whole constructed substantially in the manner and for the objects herein set forth."

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53. For *Improvements in Machinery for Shaving, Nicking, and Re-shaving Wood Screws;* Thomas J. Sloan, City of New York, October 21.

Claim.—"Having thus described the principle or character of my invention, and the manner of constructing and using the same, I wish it to be distinctly understood that I do not limit myself to the precise construction and arrangement of the parts, as these may be variously modified without affecting the principle or mode of operation which I have invented and claim to be new.

"What I do claim as my invention is, so combining the shifting mandrel that carries the blanks with a shaving and nicking apparatus, substantially as described, that the blank, after being shaved to give the required form to the head, and whilst held in the same mandrel, may be shifted to the nicking apparatus, and after being nicked, re-shifted back to the same shaving apparatus, to have the burs removed by the same cutter that performed the first shaving operation, as herein set forth.

"I also claim the employment of two shifting mandrels, substantially as specified, in combination with the shaving and the nicking apparatus, substantially as herein described, so that the nicking operation can be performed on one blank, whilst the first and second shaving operations are being performed on other blanks, as specified.

"And I also claim giving to the mandrel or mandrels end play in their boxes, in combination with the permanent rest at the back of the mandrel and with the cutter, substantially as specified, by means of which the same position of the blank relatively to the cutter, is obtained for the second shaving operation which it had for the first, as described."

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54. For an *Improvement in Box Openers;* George C. Taft, Worcester, Massachusetts, October 21.

Claim.—"What I claim as new in an instrument for opening boxes is, the combination of the lever with the brace, constructed and operating substantially as described, either with or without the heel."

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55. For an *Improvement in Machines for Dressing Stone;* Joseph V. Tilton, Marcellas, New York, October 21.

Claim.—"Having thus fully described the construction and operation of my machine, what I claim therein as new is, the manner of attaching the pick-head to a strong but flexible steel spring, which falls on a box spring, whereby the desirable whip or spring blow is given to the pick, substantially as described.

"I also claim the combination of the lever F, and connecting lever G, and crank screw, for graduating the action of the pick, while cutting the furrow of millstones, gradually decreasing the force of the blow as the pick approaches the feather edge of the furrow, substantially as described and represented."

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56. For an *Improvement in the Seeding Apparatus of a Seed Planter;* Cornelius C. Van Evory, Victor, New York, October 21.

Claim.—"What I claim as my invention is, giving the seed rollers an intermittent rotary motion, substantially in the manner and for the purpose set forth."

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57. For an *Improvement in Machines for Peeling and Cutting Peaches;* Joshua O. Ward, Pleasant Valley, New York, October 21.

Claim.—"What I claim as my invention is, the application of a revolving rasping surface to the purpose of peeling peaches or other like fruits; and also the method of cutting peaches by a knife revolving in a box, having an opening in the bottom, in such a manner that the stone of the peach is struck out, and the pulp thereof cut into pieces proper for drying, in the manner above described.

"And I claim the aforesaid methods of peeling peaches, and of cutting the same, as well separately as when combined together, in the manner herein before particularly described."

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58. For an *Improvement in Swinging Cradles;* Lucius F. Whitaker, Raleigh, North Carolina, October 21.

Claim.—"What I claim as my invention is, the self-adjusting pivot or connexion produced by the ball or weight M, suspended from the arc *o o*, by bent rods or hooks P P, said hooks having sufficient adhesion to communicate motion to the cradle from the motive power before described; thus constituting a sliding instead of a fixed pivot upon the end of the cradle, making it a matter of indifference on which side of the cradle the child may be lying, without stopping the motion of the cradle, which with the crank alone would stop."

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59. For an *Improvement in Portable Water Closets;* George R. Willmot, Meriden, Connecticut, October 21.

Claim.—"Having thus fully described the nature of my invention, what I claim as new is, the manner of construction as described, and for the purpose specified, viz: the vessel B, resting upon the partition *a*, in the interior of the case A, and the circular rim D, projecting a short distance over the edge of the cover C, when on the vessel B, and resting upon the top edge of the vessel B, when the cover C is off of it, in order to form the seat; the whole arrangement being covered by the cover E of the case A, substantially as set forth."

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60. For an *Improvement in Seed Planters;* Myron Cory, Jerseyville, Illinois, October 28.

Claim.—"Having thus described the nature and operation of my invention, I will now state what I claim as new. I claim the employment of the indicator I, having its ends bent as described, or in any other manner substantially the same, and secured on the main shaft, in such a manner that it can be disengaged or thrown into connexion with the wheel as desired, for the purpose of indicating the place where the corn has been planted, in the manner and for the purposes substantially as set forth."

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61. For *Improved Means for Attaching Augers, &c., to their Handles;* Merritt S. Brooks, Chester, Connecticut, October 28.

"The nature of my invention consists in attaching handles to augers and other tools, by means of a ferrule, or cylindrical slide and socket; the socket is secured to the under side of the handle, and immediately under a mortise hole; the edges of the socket are beveled and fit into notches or grooves in the shank of the auger, or other implement; the upper surface of the socket is inclined, and the shank is moved in the socket, by means of the ferrule or slide, till the beveled edges of the socket bind firmly in the notches in the shank, thus securing the implement to the handle."

Claim.—"Having thus described the nature of my invention and the manner in which it is constructed, what I claim as new is, the method of securing augers and other implements to handles, by means of a socket, ferrule, or cylindrical slide, constructed as described, viz: the socket being placed underneath a mortise hole in the handle, and perforated with an oblong slot, the edges of the slot being beveled, to correspond to notches in the shank of the implement, the upper surface of the socket being inclined, and the shank moved along the slot, by means of the ferrule or cylindrical slide, by which the beveled edges of the slot bind or wedge in the notches, and the taper form of the shank drawn firmly in the hole through the ferrule slide, substantially as described."

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62. For an *Improvement in Machines for Pegging Boots and Shoes;* Alpheus C. Gallahue, Metamoras, Ohio, October 28.

Claim.—"What I claim as new is, splitting the peg from the peg wood, and driving it into the sole of the shoe, by a single blow of the plate acting on the peg-wood, and forcing it upon the knife substantially as herein described.

"I also claim mounting the peg-wood, or block, in a vertical or sliding carriage, or the

equivalent thereof, in combination with the stop plate, knife, and fingers, operated substantially as herein set forth."

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63. For an *Improvement in Machines for Drying Bagasse;* Samuel H. Gilman, Cincinnati, Ohio, October 28.

Claim.—"Having thus fully described my improvements in apparatus for drying bagasse, I wish it to be understood, that I do not claim, for such purposes, a heated cylinder, revolving upon an inclined axis, such cylinders, in various forms, having been long in use; but what I claim herein as new, and of my invention, are, 1st, The arrangement (substantially as herein described,) of two cylinders, one so secured (by hollow bolts or rivets) concentrically within the other, as to leave between them an annular steam space, crossed by ventilating apertures, and the whole made to revolve around an inclined axis, for the expeditious drying (free from the danger of accidental ignition) of bagasse and other like substances.

"2d, The steam and condensed water pipes revolving together, (one within the other,) within a common journal bearing, and entering the steam space of the cylinder, in oppositely oblique directions, as described, for facilitating, at the same time, the discharge of the water and the admission of steam, during the revolution of the cylinder."

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64. For an *Improvement in Swinging Cradles;* Selden W. Knowles, Middletown, Connecticut, October 28.

Claim.—"What I claim as my invention is, the combination of a cradle with pendulum rods and balls or weights attached thereto, and set in a frame so as to swing therein, in the manner and for the purpose above set forth."

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65. For an *Improvement in Oil Presses;* David L. Latourette, St. Louis, Missouri, October 28.

Claim.—"Having described my invention, what I claim as new is, the combination of the heating plates with the steam chamber, substantially as herein set forth; the plates being moved parallel, and the steam tubes connecting them with the steam chamber, sliding in stuffing boxes, in a line with the motion of the plates, as above set forth, said steam chamber being placed in a proper relative position with the plates for that purpose."

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66. For an *Improvement in Piano Fortes;* Frederick Mathushek, City of New York, October 28.

Claim.—"What I claim as my invention is, 1st, The manner, substantially as herein described, of placing or arranging the strings of a piano-forte, to wit: the shorter strings, or strings of the higher octaves, across the narrower portion of the instrument, and the longer strings, or those of the lower octaves, crossing them in the direction of the greatest length of the instrument, so as to include the greatest possible size of string within the instrument, for the purposes specified."

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67. For an *Improvement in the Method of Moulding Kettles with Spouts;* Webster H. Pease, Dayton, Ohio, October 28.

Claim.—"Having thus described my method of moulding tea kettles, I do not claim any peculiarity, either in dividing the pattern, or using a green sand core; but what I do claim as my invention is, providing the pattern B, with two projections, or solid pieces, one on the underside of the spout portion, to prevent sand entering the spout when forming the green core of the body, and the other on the upper side of the spout, for forming a print in the sand, to receive the projection of a dry sand core, by the use of which, in connexion, the said dry sand spout core can be inserted in the drag portion of the mould, after the removal of B, but before the removal of A, and be held firmly in its required position; by which means the pattern A, is made to adjust the spout core, and greater truth secured in setting the spout core, and fewer defective casts result; in the manner set forth substantially in this specification and accompanying drawings."

68. For an *Improvement in Dairy Stoves;* Joel Stevens and H. J. Ruggles, West Poultney, Vermont, October 28.

"The object of this invention is to furnish for the dairy, a perfect, economical, and easily regulated heater for milk, in which it is impossible to burn the milk, and that is so constructed that the heat can at once be thrown off from the milk, by the simple movement of a compound valve."

Claim.—"Having thus fully described the improved apparatus and its mode of construction, what we claim therein is, 1st, the arrangement of the flues and valves, in combination with a water pan and fire box, substantially in the manner and for the purpose set forth.

"We also claim the combination of flues and valves, as herein specifically mentioned, for the purposes described."

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69. For an *Improvement in Machines for Taking Yeas and Nays;* Thomas B. Stout and James F. Morell, Keyport, New Jersey, October 28.

"Our invention may be divided into several parts, which are not necessarily connected, but which, when properly combined, effect the several operations of taking votes; of separating the affirmative and negative votes, of showing which class preponderates, of enumerating the number of each class, and of recording the votes, so that they can be read off as soon as they are taken; while at the same time, it effectually prevents mistakes in voting, as it shows whether any person's vote has been counted on both sides of the question."

Claim.—"What we claim as our invention is, the method of dividing the yea and nay votes, and showing the vote, by weighing the yea and nay balls, or their equivalents, in the opposite pans of a scale beam, substantially as herein set forth.

"We also claim the method of enumerating the votes upon a question, by weighing the balls, or their equivalents, by spring balances, or their equivalents, whose indexes indicate the number of ballots in their respective scale pans, substantially as herein set forth.

"We also claim the combination of the scale beam and spring balances, or the equivalent thereof, arranged substantially as herein described, for the purpose of showing, simultaneously, both the number of votes taken on each side of the question, and the relative values of the two sets or classes of votes, as herein set forth.

"We also claim the employment of mechanism, for the purpose of recording the vote, and showing whether it is yea or nay, at a single operation, substantially as herein described."

"We also claim the employment of mechanism, for the purpose of recording the vote, and showing the enumeration thereof, at a single operation, substantially as herein described.

"And lastly, we claim the employment of mechanism, for the purpose of recording and enumerating the vote, and showing whether it is yea or nay, at a single operation, substantially as herein described."

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70. For an *Improvement in Cements for Grinding Cylinders;* Jacob Stephan, Assignor to P. A. Schwartz and J. Stephan, Boston, Massachusetts, October 28.

"The nature of my invention consists, first, in the peculiar compound I employ; secondly, in the manner of employing it in the manufacture of the grinding cylinders for carding machines and other purposes, or other metallic, or wooden, or any other surfaces, wherever it is employed."

Claim.—"Having thus fully described my improved composition, and the manner of applying it, what I claim therein as new is, the composition herein described, consisting of the whey of milk, vinegar, glue, spirits of wine, and ether, substantially in the manner and for the purpose set forth.

"I also claim the combination thereof with emery, to construct a grinding cylinder, or other surface, in the manner described."

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71. For an *Improvement in Machines for Printing in Colors;* Richard S. Weaver, Maysville, Kentucky, October 28.

Claim.—"Having thus fully described my invention, what I claim therein as new is, in combination with receiving, distributing, and inking rollers, arranged as herein described,

the adjustable ink trough, provided with removable partitions and perforated side, so as to give out the ink in lines, or belts, corresponding with the lines or size of the type in the form, for the purpose herein described."

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72. For an *Improvement in the use of Steam to make Zinc White;* Henry W. Adams, Boston, Massachusetts, October 28.

Claim.—"Having thus fully described the nature of my invention, and some of the means by which the same may be put into practical use, what I claim therein as new is, mixing the vapor or gases of water or steam, with the heated vapor or zinc, or of its ores, as set forth, for the purpose of manufacturing zinc white for commercial uses.

"I also claim, in combination with the process for manufacturing zinc white, substantially as herein described, the making of hydrogen gas, for light, heat, or motive power, as herein fully set forth."

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73. For an *Improvement in Baby Jumpers;* Euclid Rice, Elizabethtown, New Jersey, October 28.

Claim.—"I do not claim the use of spring, or the means of giving motion for the purpose of exercise or amusement, as that has been before employed in a variety of ways; but I do claim the combining of springs, with a frame and seat, in the manner described, forming an apparatus for teaching children to stand and walk, and at the same time to prevent the child from bearing its whole weight upon its feet, as it sits upon the seat or saddle, and can, at its option, either stand upon its feet or sit down, and at the same time move itself in any direction with its feet, and its body securely sustained in an upright position, after the upper top is locked around its waist, in the manner described, and it can, at its option, either move by a motion of its limbs, or use the machine as a jumper for amusement, as the accompanying description and drawing represent."

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74. For an *Improvement in Apparatus for Watering Cattle;* S. W. Wood, Rochester, New York, October 28.

Claim.—"Having thus fully described my invention, what I claim therein as new is, in combination with a pump, worked by an endless chain of elastic balls, and operated upon by the weight of cattle, the spiral spring operating between a stationary collar and the movable cogged and threaded sleeve, for the purpose of more certainly running the sleeve into gear when the cattle step upon the platform, and for gradually stopping the platform as it rises, and the buckets as they run back into the stock or pipe, for the purpose of carrying back the water, as herein fully described and represented."

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75. For an *Improvement in Threshing and Separating Grain;* Cyrus Roberts and John Cox, Belleville, Illinois, October 28.

Claim.—"What we claim as our invention is, 1st, the method herein described, of constructing threshing cylinders with curved knives, or otherwise shaped in the end, for the purposes herein described.

"2d, Also the method already described, of working the separater, by means of the jumping wheels and concave tracked brackets, or by any modification of it, whereby the action is substantially the same."

Re-issues for October, 1851.

1. For an *Improvement in Reaping Machines;* Wm. F. Ketchum, Buffalo, New York patented July 10, 1847; re-issued October 21, 1851.

Claim.—"Having thus fully described my invention, what I claim therein as new is, 1st, the crooked arm or coupling piece, in connexion and combination with the rack piece, and the attaching and securing the crooked arm, (supporting and sustaining the rack piece to the frame,) at or about the centre, so as to produce a balance, by securing it at such a point on either side of the centre of the driving wheel, as shall secure the balance and give firmness to the rack piece.

"2d, I claim the endless chain cutter, in combination with the pulleys and rack teeth, for cutting grain and grass, as above set forth."

DESIGNS FOR OCTOBER, 1851.

1. For a *Design for Stoves;* Lyman Cobb, Akron, Ohio, October 14.

Claim.—"Having thus distinctly represented and described the nature and arrangement of the respective ornaments and figures upon the front and hearth plates of my Franklin stove, what I claim therein as new is, the design, configuration, and arrangement of the said ornaments, as herein designated and represented."

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2. For a *Design for Stoves;* Charles J. Woolson, Cleveland, Ohio, October 14.

Claim.—"What I claim as my invention is, the ornamental design and general configuration of the parts of my stove, as herein designated and represented."

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3. For a *Design for Cast Iron Fences;* John T. Davy, Troy, New York, October 21.

Claim.—"What I claim is, the design and configuration of ornamental iron fence railing, substantially the same as described and represented in the annexed drawings."

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4. For a *Design for Stoves;* William Savery, City of New York, October 21.

Claim.—"What I claim as original is, the design and configuration of the several ornamental figures on the front and side plates and doors of a certain stove, as represented in the annexed drawings and as above described."

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5. For a *Design for Stoves;* Ezra Ripley, Troy, Assignor to Chollar, Sage, & Dunham, West Troy, New York, October 28.

Claim.—"What I claim as new is, the design of ornament and configuration of cook stove, substantially the same as herein described and represented."

NOVEMBER.

1. For an *Improvement in Air Engines;* John Ericsson, City of New York, November 4; patented in England, December 26, 1850.*

Claim.—"What I claim as my invention is, the working cylinder and piston, and the supply cylinder, and piston of less piston surface; the two pistons being connected with each other and working together substantially as specified, in combination with the regenerator and heater, so that the air or other circulating medium shall pass from the supply cylinder to the working cylinder, through the regenerator, substantially as specified, and give motion to the engine, through the difference of area of the pistons; and this I claim, whether the air or other circulating medium be made to pass on the return stroke from the regenerator to the supply cylinder, or any other receiver, or into the atmosphere.

"I also claim in connexion with the working cylinder, the employment of two regenerators, substantially as specified, in combination with the valves or their equivalents, for the purpose of causing the air or other circulating medium to pass, during a series of strokes, through one of the regenerators to the working cylinder, and back from the working cylinder through the other regenerators, and then reversing the action, substantially as specified.

"I also claim interposing the heater between the regenerator and the working cylinder, substantially as specified, to heat the air or other circulating medium, as it passes from the regenerator to the working cylinder, as specified, to supply the heat required.

"And finally, I claim communicating the power of the engine to the working beam, or its equivalent, by the attachment thereof, to one of the pistons, or piston rods, between the open ends of the two cylinders, said pistons being connected or braced to each other, substantially as specified, whereby I am enabled to render the engine compact, and effectually to brace and connect the two pistons, and avoid undue strain, as specified."

* See page 228.

2. For an *Improvement in Machines for Forming Horse Collars;* Isaac Davis, Mechanicsburgh, Ohio, November 4.

Claim.—"What I claim as my invention is, the combination of the moving tapering block with the adjustable stationary dies, the two being constructed and arranged substantially as herein set forth."

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3. For an *Improvement in Cultivators;* Isaac Constant, Buffalo Heart Grove, Illinois, November 4.

Claim.—"What I claim is, the intermediate jointed ploughs, in combination with the main cultivating ploughs as described, for enabling the ploughman to plough nearer to or further from the rows, at will."

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4. For an *Improvement in Seed Planters;* Newton Foster, Gilbert Jessup, Hiram L. Brown, and Calvin P. Brown, Palmyra, New York, November 4.

Claim.—"Having thus described the nature and operation of our invention, what we claim as new is, in combination with the seed box and cap, arranging the rotating disk vertically, and providing it with projections, and the stationary vertical dies provided with an opening for receiving the grain, and the flanches between which the said projections rotate, and by which the grain is carried from the seed box to the cap, and thence to the seeding tube; the whole being arranged in the manner and for the purpose specially set forth and described."

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5. For a *Machine for Measuring and Cutting Iron;* Levi B. Griffith, Honeybrook, Pennsylvania, November 4.

Claim.—"What I claim as my invention is, the measuring wheel, placed in any suitable position, in combination with the cutter, bed plate, and spring, or its equivalent; the whole being arranged and combined, substantially as described, for the purpose herein set forth."

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6. For an *Improvement in Desks;* John T. Hammitt, Philadelphia, Pennsylvania, November 4.

Claim.—"Having thus fully described the construction and operation of my elevating desk, what I claim as new and of my invention is, the raising of a horizontal surface at the back part of the desk or table, when the front part is being raised to form an inclined plane, by means of the arrangement of the screw and lever, or any analogous device, the front part being hinged to the elevating frame, the same to be applied to standing or sitting desks or tables, substantially in the manner and for the purpose set forth."

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7. For an *Improvement in Radiating Surfaces;* Joshua K. Ingalls, Bushwick, New York, November 4.

Claim.—"What I claim is, the application of the tapering form to radiating surfaces, constructed in the compact and available manner above described."

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8. For an *Improvement in Tanners' Oil from Resin;* Louis S. Robbins, City of New York, November 4.

Claim.—"What I claim as my invention is, the new and original product or manufacture which I denominate Robbins' tanners' oil, or Robbins' curriers' oil, the process of producing which I herein fully set forth; I also claim every use and application of my said oil."

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9. For an *Improvement in Lubricating Oil from Rosin;* Louis S. Robbins, City of New York, November 4.

Claim.—"What I claim as my invention is, the new and original product, or manu-

facture which I denominate Robbins' lubricating oil, the process of producing which I have herein fully set forth.

"I also claim every use and application of the said oil."

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10. For an *Improvement in Distilling Naphtha from Rosin;* Louis S. Robbins, City of New York, November 4.

Claim.—"Having thus fully described my new and improved process of distilling rosin, what I claim therein as my invention is, 1st, the process of separating the acid and water arising from the decomposition of rosin, at the temperature of 325 degrees Fahrenheit, or thereabout, by means of fire heat, substantially in the manner herein set forth.

"I also claim, in combination with the above, the process of separating the naphtha from the other component parts of the rosin, by preserving the temperature of the liquid mass within the still at about the range of 325 degrees Fahrenheit, as above stated, and injecting steam into the same; by which I am enabled to throw off the naphtha at the same temperature employed for throwing off the acid.

"I do not intend to limit my improved process of distillation, as herein before described, to the production of oil from rosin, but shall employ it for redistilling the crude article known as rosin oil."

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11. For an *Improvement in Paint Oil from Rosin;* Louis S. Robbins, City of New York, November 4.

Claim.—"What I claim as my invention is, the new and original product of manufacture which I denominate Robbins' paint oil, the process of producing which I have herein fully set forth.

"I also claim every use and application of my said oil."

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12. For an *Improvement in the Manufacture of Charcoal;* Wm. P. McConnell, Washington, District of Columbia, November 4.

Claim.—"What I claim as my invention is, the iron cylinder with a double bottom, the upper one being perforated, and these combined with several flues covered at the top with dampers, and protected within with iron rings, the whole so constructed that the fire may be applied either on the top, under the bottom, or within the flues, or in all together at pleasure; and the whole adapted as herein described to the uses and purposes specified, and these only."

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13. For an *Improvement in Folding Doors of Stoves;* James Root, Cincinnati, Ohio, November 4.

Claim.—"Having thus fully described my improved doors for grates and stoves, what I claim therein as new is, the sliding and folding doors, in combination with pilasters, by which I prevent the heating of the doors and warping consequent thereon, and admit a free radiation of heat from the side of the stove, substantially in the manner and for the purposes set forth."

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14. For an *Improvement in Processes for Dyeing Blue;* Edward Swiney, Andover, Massachusetts, November 4.

Claim.—"I claim as my invention, the mode of producing a dark blue, or color, to take the place of indigo, which color can be produced at a very great saving of expense in comparison to that incurred by the employment of indigo in the usual way.

"I do not mean to claim the use of a prussiate of potash dye alone, but do claim the employment of such dye, in combination with either one or more of the above named woods, substantially in manner as specified."

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15. For an *Improvement in Compounds for Extinguishing Fires;* Joshua Upham, Salem, Massachusetts, November 4.

Claim.—"I am aware that it is known that sulphurous acid gas will extinguish the

flame of a taper or any such like small flame; I therefore do not claim such as my invention; but what I do claim is, the application of a compound of sulphur and nitre in a state of combustion, within a room or apartment on fire, for the purpose of extinguishing the fire tending to destroy the said room or building thereof."

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16. For an *Improvement in Springs;* James Webster, Leicester, England, November 4; patented in England, February 11, 1851.

Claim.—"Having described the nature of my said invention and the manner of performing the same, I declare that I claim as my invention, the above specified mode of arranging or combining springs and inclined planes or surfaces, curved or plane, so that the points or arms of the springs may be applied to, or press against the inclines, or inclined planes, for the purpose of thereby obtaining the action of such springs, in manner hereinbefore described."

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17. For *Improvements in Planing Machines;* Geo. W. Beardslee, Albany, New York, November 4.

"The nature of my invention consists in the application of springs, or weights, to each edge and end of cutter stocks, on which knives with caps are bolted, for the planing of boards or plank, whereby they are caused to yield both on the heel and edge."

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, the application of springs or weights to cutter stocks, both at their point in line with the cutting edge of the knife, and also to the heel, by which a double action is given to the stock, both at the heel and edge, allowing it to rise and oscillate to the inequalities of boards or plank, substantially as described and for the purposes herein set forth."

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18. For an *Improvement in Carriage Springs;* Levi Bissell, City of New York, Assignor to himself and Lyman Kinsley, Canton, Massachusetts, November 4.

Claim.—"My improvement, and therefore what I claim, consists in combining buttress blocks, with the wood bar, and the metallic strap bar, in such manner, substantially as specified, so that such blocks, when the spring is in use, shall act as levers to compress the wood and counteract the tendency of the fibres to be elongated and ruptured by the downward strain."

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19. For an *Improvement in Machines for Dressing Staves;* Lewis S. Chichester, Williamsburgh, New York, November 4.

Claim.—"What I claim as my invention is, dressing staves by means of stationary knives, in combination with a pressure roller directly over the cut, when this is combined with the bed, constructed with a raised portion when the cutting is done, for the purpose of allowing a crooked or bent stave freedom of motion while being dressed, substantially as described."

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20. For an *Improvement in Bating and Tanning Hides;* Wm. B. Milligan, Edinburgh, Virginia, November 4.

Claim.—"What I claim as my invention is, the method herein described, of bating hides and other skins in the process of tanning, by subjecting them to a vapor bath applied substantially in the manner herein described.

"I also claim the combination of the rocking frame and the shaft above, the two being connected as herein set forth, in such manner that the shaft may be used either to rock the frame or to raise it from the vat."

LAW REPORTS OF PATENT CASES.

FRENCH, et. al., *vs.* ROGERS, et. als.

***Morse and Bain Telegraph Controversy, tried in the Circuit Court of the United States for the Eastern District of Pennsylvania, during the month of September*, 1851.**

Reported for the Journal of the Franklin Institute.

This cause was commenced by a bill in Equity, filed on the 12th of July, 1850, in behalf of B. B. French and others, as trustees of the Magnetic Telegraph Company. This Company are vested, by assignments from Professor Morse, with the exclusive right to use his inventions and improvements in telegraphing on the line between the cities of New York and Washington.

Professor Morse had obtained three patents from this Government for his several improvements.

The first and principal one of these patents was issued to Prof. Morse on the 20th of June, 1840, and was corrected by two subsequent re-issues. This patent, it was alleged in the bill of the complainants, secured to Morse and his assignees, among other things,

I. The exclusive use of Electro-Magnetism for *recording* intelligence at a distance.

II. The exclusive use of a system of signs, composed of dots and lines, for telegraphing.

III. The exclusive use of combined galvanic circuits for telegraphing.

Professor Morse's second patent was issued April, 11, 1846, and was afterwards re-issued in a corrected form. This patent, it was alleged in the bill of complainants, secured to Morse and his assignees, the exclusive right to use a peculiar adjustable device, called by Morse a receiving magnet, to combine together a long telegraphic circuit and one or several short telegraphic circuits.

The third patent of Prof. Morse, it was alleged, secured to him and his assignees the exclusive right to record the system of dots and lines of his first patent by means of simple chemical decomposition.

The complainants' bill further stated that the respondents had erected a line of telegraph, on which they employed the agency of electro-magnetism for recording at a distance, and that they used the same system of signs Morse had patented,—the same combination of receiving magnet and local circuits,—and that they had recorded Morse's signs by chemical decomposition. That by so doing, they infringed upon complainants' rights as assignees of the three above named patents of Prof. Morse.

The complainants' bill prayed for the usual remedy by writ of injunction, and that the respondents be ordered to account to the complainants for the profits which they have derived by their infringement.

The respondents filed on the 25th of September, 1850, an answer to the above bill of complaint, and stated, among other things, that Morse was not the inventor of the several things claimed by him. That Prof. Henry, of Princeton, had preceded him in some material part, if not

all, of his invention in regard to the employment of electro-magnetism for recording at a distance, by a publication in the 19th volume of Silliman's Journal, and by statements to his class at Princeton College.

It was alleged that Harrison Gray Dyar had erected a recording telegraph on Long Island in 1827, and had used substantially the same system of signs as Morse has patented.

That the same system of signs was described in a book called the "Mural Diagraph," published by James Swain, at Philadelphia, in 1829.

That the telegraph of Gauss & Weber, of Gottingen, that of Schilling, and that of Cooke & Wheatstone, of England, involved substantially the same use of electro-magnetism, and that these were anterior in point of date to Prof. Morse's invention, or to the issuing of his patent.

That Steinheil had invented a recording telegraph, using electro-magnetism, and that a description of this invention was published in September, 1838, and defeated Prof. Morse's right to a patent for the exclusive use of electro-magnetism for recording at a distance.

That Dr. C. T. Jackson, of Boston, during a voyage on board the "Sully," from France, in 1832, had invented the art and mechanical means of telegraphing patented by Morse, and communicated these to Morse.

That Messrs. Cooke & Wheatstone, and Charles Davy, of England, had preceded Morse in the invention of combined circuits for telegraphing generally, and in the employment of a receiving magnet to connect a long circuit to one or more local circuits.

That Prof. Henry had also preceded Morse in the invention of combined circuits for telegraphing, and in that of the receiving magnet and local circuit arrangement of Morse's second patent.

The respondents alleged that Alexander Bain and others had preceded Morse in recording the dot and line alphabet by chemical decomposition, as described in Morse's chemical patent.

The respondents further said that they did not infringe either of Prof. Morse's patents; that they used what they called a branch circuit, which was a new invention of H. J. Rogers', different from Morse's local circuit; and that they had so modified their system of signs as to make it entirely different from Morse's system, and no infringement, and that their use of electro-magnetism was not an infringement.

The respondents also set forth that Prof. Morse's original patent was invalid, because the Commissioner of Patents had not made it to bear date from the date of a French patent which Morse had taken out for the same invention before his American patent was issued.

The complainants denied that any one was prior to Morse in the invention of the things claimed by him, and denied that he had derived any material part of them from any other person, and controverted all the matters of law and fact alleged by the respondents.

The foregoing were the principal questions raised by the bill and answer. There were also some secondary questions as to the identity of the original patents and the re-issues,—the patentability of certain claims, and the sufficiency of description of certain portions of these patents.

Notice was given by the complainants in July, 1850, that an application would be made in the ensuing September for an interlocutory injunction. This application was not then pressed, but a day was fixed

for final hearing, and the respective counsel and parties commenced taking testimony in support of their several positions. The taking of the testimony in this case consumed nearly six months, and occupied over 1000 closely printed pages. On behalf of the complainants, there were examined Professors Byrne, Barrett, Chilton, Renwick, and Chester, of New York; Professors Frazer, Tilghman, and Wetherill, of Philadelphia, and Gale and Page, of Washington. And on behalf of the respondents, Professors Henry, Walker, Mathiot, Keith, and Benedict, of Washington; Jackson, Channing, Horsford, Hayes, and Gould, of Boston; Ellet, Gibbs, and McFarlane, of New York, and Henry D. and James B. Rogers, of Philadelphia.

Harrison Gray Dyar was examined as to his telegraph on Long Island.

The case came up for final hearing before Judges Grier and Kane, on the 15th of September last, and was argued by Messrs. Campbell, Kendall, Gifford, and Harding, for the complainants, and Messrs. Meredith, Gillette, McCall, and Schley, for respondents.

In addition to the points set out in the bill, it was contended, in argument on behalf of the complainants, that the law requires only that the re-issued patent should be for the same invention for which the original patent was granted, and not that the original and re-issued specifications or claims must be identical; citing Sloat *v.* Spring, et al.; Woodworth *v.* Wilson; Allen *v.* Blunt; 3 Story, 74[illegible], and others.

That an "art" is patentable under our patent laws, as well as a mechanical instrument or combination; citing Whittemore *v.* Cutter, 1 Gall. 498; Crane *v.* Price, Webster's P. C., 409; Parker *v.* Hulme, and other cases. That he who discovers a principle and devises one mode, by which the same can be rendered practically useful, is entitled to protection against all other devices for using that principle.

It was contended on behalf of the respondents, that printed publications of any matter or thing claimed in Morse's patent, made prior to the date of his *application*, render his patent invalid. That Morse's re-issued patents were void because the claims were varied from those of the original patents. That a patentee cannot cover all modes of using a power or result, but is confined to the particular mode invented by him. Stone *v.* Sprague, 1 Story, 270, and other cases.

When a patent is for a combination of parts, and not for the different parts composing the combination, the use of any parts less than the whole is not an infringement. Barrett *v.* Hall, 1 Mason, 447, and other cases.

An invention is not complete so as to be patentable, or to bar the obtaining a patent by another inventor, until it is perfect and adapted to use. Reed *v.* Cutter, 1 Story, 590, and other cases.

The argument occupied the undivided attention of the Court for several weeks. In the course of the argument numerous drawings, working models, and experiments, illustrative of the inventions of Prof. Morse, the telegraph of the respondents, and the principles of science involved in the contest, were exhibited on behalf of the respective parties. The questions of law raised were elaborately argued, and a large mass of authorities discussed.

On the 3d of November, Judge Kane delivered the opinion of the Court, Judge Grier expressing his full concurrence therein.

OPINION OF THE COURT.

This case is before us on final hearing upon the pleadings and proofs.

Professor Morse, under whom the complainants hold, has three patents: the first, dated 20th June, 1840, re-issued after surrender on the 25th January, 1846, and again re-issued after a second surrender on the 13th June, 1848, which has been referred to in the argument as the Magnetic Telegraph Patent; the second, dated 11th April, 1846, also re-issued on the 13th June, 1848, referred to as the Local Circuit Patent; the third, dated 1st May, 1849, referred to as the Chemical Patent. The Bill charges that the respondents have infringed all three of these patents: the answer denies the infringements, and controverts the validity of the patents.

I. The objections to the validity of the first patent, that for the Magnetic Telegraph, are stated in the defendants' brief, as follows:

"I. That it does not run from the date of Morse's French patent.

"II. That the Commissioner of Patents had no authority in law to re-issue a second time.

" III. That the claims set out in the first re-issue are broader than the claims in the original patent; and the claims in the second re-issue are broader than those of either of its predecessors, and are not for the same invention."

1. The first of these objections founds itself upon the fact, that Mr. Morse had obtained a patent in France for this same invention twenty-two months before his patent issued here; and it asserts, that under the second proviso of the 6th Section of the Act of 1839, his American patent should in consequence have been limited to the term of fourteen years from the date of the French patent; and that not having been so limited, it is void.

This objection was fully met in the argument of the complainants. Mr. Morse's application for a patent in this country was made in April, 1838, and was filed and acted on in the Patent Office before the 10th of that month; his French patent bears date the 18th of August following. There is therefore no room for the questions, which were argued so elaborately, of the proper interpretation of this proviso in the 6th Section of the Act of 1839, and the 8th Section, second clause, of the Act of 1836, which was also invoked, in any possible bearing upon the case of Mr. Morse. The proviso of 1839 must be interpreted by reference to the enacting words of the section which it limits; and the provisions of both the sections relate only to such patents as are *applied for* here, after the issue of a foreign patent. But Mr. Morse's application here was before his patent abroad—in nowise after it;—and his American patent was granted therefore under the general enactments of the Act of 1836, not under any special proviso or exception whatever; and its term runs properly from its date.

We do not see the justice of the criticisms upon his application, that the jurat affixed to it is without date of day or month; and that the drawings, which accompanied it, were not in duplicate. There is no act that requires the jurat to be dated at all; and the supplementary provision of the 6th Section of the Act of 1837, that "the applicant shall be held to furnish duplicate drawings," though directory in its terms, is not a condition; and it has obvious reference in point of time to the issuing of the patent, and not to the filing of the petition for it. Such has hereto-

fore been the interpretation of the Patent Office, announced in the official circulars for the instruction and guidance of inventors; the practice founded on it is both reasonable and convenient; and no Act of Congress appears to conflict with it. If Mr. Morse's patent is invalid on this ground, more than half the modern patents for mechanical inventions must probably fall with it.

2. The second objection to the patent is, that the Act of Congress makes no provision for a second surrender and re-issue.

The 13th Section of the Act of 1836, which provides in certain cases for the surrender of a defective patent, and its re-issue in an amended form, regards the new patent as substituted for the old one, with just the "same effect and operation in law" as if the specification had been filed at first in the form which it takes in the re-issue. It is difficult to see why, if the original patent could be amended, its substitute, having all the legal attributes of the original, cannot be amended also.

There is nothing in the words of the act, or in the policy which it proclaims, that limits the correction of errors to such as may have been the first discovered. On the contrary, if it be true, as we have supposed in determining the recent case of Battin *vs.* Taggert, that the patent is granted to the inventor in consideration of some benefit to be derived by the public from his disclosures, and that the re-issue is in consideration of some more full or more accurate disclosure than that which he had made in his original specification, or some renunciation on his part of an apparently secured right,—it is for the public interest, that the surrender and re-issue should be allowed to follow each other, just as often as the patentee is content to be more specific or more modest in his claims.

Besides, it might not be safe to assume too readily, that the act was intended to withdraw altogether from the officers of the executive department the power, which they had before, to accept a surrender and grant a re-issue, and which would sanction a second re-issue quite as readily as a first. The act might perhaps be regarded more justly as affirming the propriety of the usage which had obtained under the former laws, and had been repeatedly recognized by the Courts, (Morris *vs.* Huntington, 1 Pain. 355-6; Grant *vs.* Raymond, 6 Pet. 220; Shaw *vs.* Cooper, 7 Pet. 315,) and as prescribing in addition the conditions and incidents which should attach to it thereafter in certain cases. It is hardly to be supposed that the merely clerical error of an engrossing subordinate, or the accidental inadvertence of the Commissioner himself, is not capable of being rectified or supplied now, just as it was before the passage of the act. And yet the construction, which regards this section as superseding the implied power of the Commissioner, might lead to this, since the act makes no provision for correcting such mistakes on the part of the patent officers.

Still further: it must, as we think, be conceded, that if the Commissioner's power to re-issue, is so restricted by the Act, as to be exhausted by a single exercise, his power to accept the surrender must be equally restricted, and equally transitory. And the argument then resolves itself only into another form of the question, whether the patent was for any purpose a valid one as it stood after the first re-issue; because, if the second re-issue was invalid for want of authority to make it, the second surrender was ineffective for want of authority to accept it—and so the patent

stands as if it had not been surrendered the second time. The surrender and the re-issue, no matter how often they recur, are reciprocal—each in consideration of the other—and forming together but a single act between the parties. It would be unconscientious to retain the consideration, while denying the validity of the grant. See Woodworth *vs.* Hall, 1 Wood C. & M. 400.

3. We pass to the third objection, the supposed variance in the re-issues.

From the course of some parts of the argument on this point, it might be inferred that the objects as well as the import of the 13th Section of the Act of 1836 had been misapprehended by the learned counsel for the respondents. It is not the meaning of the law, that the patentee who applies for a re-issue, must at his peril describe and claim in his new specification, either in words or idea, just what was described and claimed in his old one. His new specification must be of the same invention, and his claim cannot embrace a different subject matter from that which he sought to patent originally. But, unless we narrow down the correction which the statute contemplates, till it becomes a mere *disclaimer*, it is not possible in any case to frame a corrected specification, which shall not be broader than the one originally filed. To supply a defect, to repair an insufficiency, is to add—either directly or by modifying or striking out a limitation:—in either form, the effect is to amplify the proposition,—in the case of a specification under the patent laws, it is to amplify the description and enlarge the claim.

There are few things more difficult, even for well educated and practised lawyers, than to describe a new invention clearly, and point out the principle which distinguishes the subject of it from all things known before:—And as inventors are rarely experts either in philology or law, it has long been established as a rule, that their writings are to be scanned with a good degree of charity. But it is easy to abuse this liberality to the purposes of fraud. The public has rights to be guarded also; and these exact, that the patentee's specification shall set forth his invention so fully and definitely that it cannot be readily misunderstood.

It is the purpose of the statute, to reconcile this seeming conflict; and it effects it by allowing the inventor to amend the mistakes he has honestly fallen into in his description and claim of title, as soon and as often as he discovers them. And there is the more reason for this indulgence, since under the act of 1836, sec. 7, the specification is reviewed by the Commissioner before the patent issues, and is very often modified in accordance with his suggestions, or to obviate objections made by him to its original form. He may be supposed to know, therefore, better than any one else but the patentee himself, what the invention was for which the patent was sought at first, and he may also know whose inadvertence, accident, or mistake it was, that made the first specification inoperative or invalid. It is not absolutely impossible that it may have been his own; as certainly it had his implied concurrence.

And this consideration furnishes a strong argument for the rule, that the Commissioner's action in ordinary cases of re-issue shall have more than a *prima facie* influence in finally deciding the question of identity of invention. Whatever be the extent of that rule; whether it leaves nothing open for discussion before the Court, but the issue of fraud; as appears to

have been the undivided opinion of the Supreme Court, in the case of Simpson, 4 How. 404; or whether we permit ourselves to except from it, as we did in Battin *vs.* Taggert, cases in which the invention claimed in the re-issued patent is obviously different from that claimed in the original; or whether, with Judge Story, in Allen *vs.* Blunt, 3 Stor. 740, and in Woodworth *vs.* Stone, *ibid.* 749, we hold the grant of the amended patent to be "conclusive as to the existence of all the facts, which by law are necessary to entitle the Commissioner to issue it; at least, unless it is apparent, on the face of the instrument itself, without any auxiliary evidence, that he was guilty of an excess of authority, or that the patent was procured by a fraud between him and the patentee." Whatever be the rule, or its limitations, the propriety of the re-issue in the case before us can hardly claim a judicial review. There is no want of jurisdiction, either apparent on the face of the proceedings or asserted by the evidence; and there is no fraud imputed, or justly imputable.

Nor is there any flagrant diversity of claim. After a repeated and careful examination of the three specifications, with their respective claims, fully aided by the acumen of highly ingenious counsel, we have not found a material difference of import between any of them. The order in which the subjects of claim are marshalled is not the same throughout; a phrase is more concise in one, in another more popular; in one a scientific term, or a general expression, takes the place of the descriptive or defining language, or the detailed particulars of another; in a word, they are unequal as specimens of artistic writing, and a close examination may detect defects in the two first, which are repaired in the last. But they all describe the same thing essentially; and we should find it easier to argue, that neither the first nor the second specification could be rightfully regarded as "inoperative or invalid" for want of precision and clearness than that there was an important variance in the second from the first, or in the third from either.

These observations form the answer to the third objection.

Mr. Morse's patent of 1840, in all its changes, asserts his title to two distinct patentable subjects; the first, founded on the discovery of a new art; the second, on the invention of the means of practising it.

1. That he was the first to devise and practise the art of recording language, at telegraphic distances, by the dynamic force of the electro-magnet; or, indeed, by any agency whatever, is, to our minds, plain upon all the evidence. It is unnecessary to review the testimony for the purpose of showing this. His application for a patent, in April, 1838, was preceded by a series of experiments, results, illustrations, and proofs of final success, which leave no doubt whatever but that his great invention was consummated before the early spring of 1837. There is no one person, whose invention has been spoken of by any witness or referred to in any book, as involving the principle of Mr. Morse's discovery, but must yield precedence of date to this. Neither Steinheil, nor Cook and Wheatstone, nor Davy, nor Dyar, nor Henry, had at this time made a recording telegraph of any sort. The devices then known, were merely *semaphores*, that spoke to the eye for the moment—bearing about the same relation to the great discovery now before us, as the Abbé Sicard's invention of a visual alphabet for the purposes of conversation bore to the art

of printing with movable types. Mr. Dyar's had no recording apparatus, as he expressly tells us; and Professor Henry had contented himself with the abundant honors of his laboratory and lecture rooms.

When, therefore, Mr. Morse claimed, in his first specification, "the application of electro magnets" "for transmitting, by signs and sounds, intelligence between distant points," and "the mode and process of recording or making permanently signs of intelligence transmitted between distant points;" and when in his second specification he claimed "the making use of the motive power of magnetism, when developed by the action of currents of electricity, as a means of operating and giving motion to machinery, which may be used to imprint signals upon paper or other suitable material," "for the purpose of telegraphic communication;" characterising his "invention as the first recording or printing telegraph by means of electro-magnetism;" and when, in his third, after again describing his machinery and process, he once more characterised it in the same terms, and claimed "as the essence of his invention the use of the motive power of the electric or galvanic current, (electro-magnetism as he now terms it,) however developed, for marking or printing intelligible characters, signs of letters at any distance;" through these several forms of specification, claiming and renewing his claim of property in the same invention, as it seems to us—and claiming in each and all of them no more, as it also seems to us, than he was justly entitled to claim,—he declared the existence of a new Art, asserted his right in it as its inventor and owner, and announcing fully its nature and elements, invoked in return the contracted protection of the Laws.

From this time his title was vested as patentee of the art, and other men became competitors with him only in the work of diversifying and perfecting his details. He himself used the *stylus*, to impress paper or parchment, or wax coated tablets, it may be; though he sometimes made a colored record by the friction of a pencil: another substitutes a liquid pigment, or stains his paper with a chemical ink: the next perhaps stains his paper beforehand, and writes on it by decomposing the coloring matter: and another yet more studious of originality than the rest, writes in a cyclovolute, instead of a straight line, and manufactures his ink as he goes along, by decomposing the tip of his stylus on a chemically moistened paper. They are no doubt all of them inventors; as was the man who first cast types in a mould, or first bent metal into the practical semblance of the gray goose quill, or first devised sympathetic ink, that the curious in letter writing might veil their secrets from the profane. All these toiled ingeniously and well, to advance and embellish a pre-existing art. But they had no share in the discovery of the art itself, and can no more claim to share the property, which its discovery may have conferred on another, than he who has devised some appropriate setting for a gem, can assert an interest in the gem itself.

Yet admitting, for the sake of argument, that Mr. Morse's leading invention is correctly designated as a new art; and that he has sought to patent it accordingly, by a compliance with all the requisitions of the statute—it is still contended, and with much of elegant research into the radical meaning of the term, that an art, as such, cannot be made the subject of a patent. But interpreting language as men use it around us

and as it reflects ideas, the question can hardly be regarded as doubtful. The constitutional provision, under which our patent laws are framed, looks to the promotion of "useful arts." The Act of Congress places "a new and useful art" among the discoveries it professses to protect, and assigns to it the first place on the list. The statute of 21 James I, c. 3, from which the patent system of England has grown up, speaks only of "new manufactures:" Yet the Judges of that kingdom find a warrant in this limited expression for sustaining patents for an art, and even for the renewed discovery of an art that had been lost. (See the Hot Blast case, *Webster P. C.* 683, 717, and Mr. Webster's note at p. 718, and the case of Wright's patent, *ibid.* 736, and the cases grouped in Hindmarch, pp. 77-102.)

Indeed, the author whose treatise we have cited last, asserts with much emphasis, that it is the art, and nothing else, which is the characteristic subject of every privilege granted by a patent under the statute: *p.* 92. And it may be noted, as not without interest, that in just accordance with the spirit of the English law cases, the English patents of Cooke and Wheatstone, Davy, and Bain, claim property in the arts for which their mechanical devices are respectively adapted; not, indeed, in so many words, but in language as unequivocal as that employed by Mr. Morse.

Nor can we see that there is any reason of policy, which should deny protection to an art, while extending it to the machinery or processes, which the art teaches, employs, and makes useful. Why should the type, or the inkball, or the press itself, be dignified beyond the art, to which they minister in such humble subordination, and without which they are rubbish? Will you patent the new product, and the new elemental means, and the new process by which they act, and then debate whether you may patent the art? You have patented it already.

We are aware, of course, that it has been held in some cases under the English patent law, that the art to be patented must have some reference to a manufacture. (See Hindmarch, *ut supra.*) But while such a deduction might be legitimate from the words of the statute of James, it would be obviously otherwise under the more liberal phraseology of our Act of Congress. And even in England, it must be apparent to every one who has watched the progress of their patent system, that this limitation is practically disregarded already, and that it is to be repudiated as soon as it shall interfere with the protection of an important invention.

Yet, in truth, there are few discoveries of practical moment to the daily concerns of men, even in the lapse of many years, that are not more or less directly connected with some department of manufacturing industry or skill. The convex lens—the steamboat—the iron road, on which cars are propelled by the friction of driving wheels—some of these may be so indirectly connected with manufactures, or rather they are associated so intimately with the leading pursuits and interests and enjoyments of all of us, to make it difficult to refer them to the category of a particular manufacture. Would it not be strange if, on this account, they were excluded from the benefits of the patent system? If we go back to the early story of our race, and mark the stages of its long and difficult advance,—from language, the first exponent of thought, to letters, its first record,—and from letters to printing, which first diffused letters, widely

though slowly, among men,—and from printing, to the telegraph, the electric register of thought, spreading its fibres of sympathy over the intelligent world, and making it throb simultaneously everywhere, as with the pulsations of one heart;—who will say that each transition between these great epochs, that signalize the moral and intellectual progress of mankind, should not be marked by a memorial as stately, as the first clipping of a cut nail, or the compounding of a new variety of liquid blacking? or that the men, to whom we owe them, should not be dealt with as liberally, or at least as justly, by the State?

2. The second general subject of Mr. Morse's patent of 1840 includes many particulars; all of them interesting and valuable in connexion with the claim we have just been considering. Taken together, they give a practical form to his leading invention, and guard it from the imputation of being a mere abstract notion, a principle resting in idea. Taken singly, some of them appear to us to be new; as his alphabet (*claim* 5); his combined series (*claim* 4), by which the electric current from one battery, before entirely expending itself in its lengthened circuit, is made to set another battery in action, from which another circuit traverses to a battery still beyond,—and so onwards; his adaptation of clock-work to the recording cylinders, (*claim* 2):—others again are only new, as they are elements of a novel combination. There is no proof before us, that any of the devices, which Mr. Morse has claimed in this patent, whether as independent inventions or parts of a combination, are not really his so far as he has claimed them. It is unnecessary to discuss them in detail, for they are all substantially protected, as appliances of the Art, which is the great subject of his patent.

II. The second patent of Mr. Morse is for what has been termed his Local Circuit. To understand the questions which arise upon this, it is necessary to refer back to the apparatus which he had patented before, and to explain in general terms its principle and modes of operation. I shall attempt to do this in popular language, and without stopping to consider very carefully the varying niceties of scientific nomenclature.

It is well known that a current of galvanic electricity, while passing along a wire that has been wound spirally round a bar of soft iron, communicates to the iron a certain degree of magnetic virtue, and that the iron loses this magnetic character again as soon as the electricity ceases to pass along the wire that surrounds it. It is also well known that the electric fluid may be passed along a wire of great length, and yet retain even at the farthest extremity of the wire a sufficient degree of energy to impart this occasional magnetism to the iron, and to make it capable for the time of attracting any small body of iron that may be near it. If such a small body of iron be made to form the extremity of a nicely balanced lever, it is plain that while the one extremity of the lever is attracted towards the temporary magnet, the other extremity will be moved in the opposite direction; and if to this other extremity we affix a pencil or stylus, this will press upon whatever surface may be interposed in the way of its motion, and may either mark the surface, or, if it be of a yielding nature, indent it. It is plain also, that when the bar of soft iron ceases to be magnetic, in consequence of the electric fluid ceasing to pass round

it, the lever will take its original position, and the stylus ceases to press upon the resisting surface.

If, now, we suppose that surface to be moved uniformly below the stylus, it is obvious that the surface will be marked with a straight line, and that this marked line will be interrupted during any intermission of the electric current, so as to form a broken series of straight lines, or if the electric current passes and intermits in rapid alternation, a series of dots or points. These broken traces of the stylus, the lines and dots, constitute the *alphabet* of Mr. Morse; a certain succession of either or a certain combination of the two being arbitrarily chosen to indicate a particular letter.

The galvanic battery generates the electric fluid continuously, whenever the two extremes or poles of the battery are connected by a suitable conducting medium—such as a metallic wire, water, or the earth itself—along which *conductor*, as it is called, the electric fluid may pass between one pole of the battery and the other, thus performing what is termed an *electric circuit.*

Let us now extend a continuous wire from one of the poles of the galvanic battery to a distant point, taking care that it shall not be intermediately in contact with the earth or with any other good conductor of electricity, and let us at the distant point pass the wire in a spiral coil round a bar of soft iron, and thence lead it back again to the other pole of the battery, or avail ourselves of the earth itself as part of the circuit. It is obvious from what we have said before, that the electric fluid, passing from the battery along the wire, around the occasional magnet, and back to the battery, and then at appropriate intervals of time interrupted in its circuit, will cause the stylus to make its trace of lines or dots, or in other words its alphabetical record, at the distant station.

It only remains then to devise a mode of interrupting and renewing at pleasure the flow of the electricity—*breaking and closing the circuit*, in the language of the experts. This is done by dividing the wire near the battery, and then arranging a simple finger key, which, when struck or pressed upon by the finger, brings a short metallic conductor into intimate contact with the two ends of the divided wire, and thus restores the continuity of the circuit while the pressure continues on the key. This may serve as a rude explanation of Mr. Morse's Electro-Magnetic Telegraph in its simplest form.

It was found, however, at an early period, that though the electric current was still appreciable after it had passed over a great length of wire, yet in traversing the very long circuits that were required to include distant telegraphic stations, it ceased to impart a sufficient degree of energy to the temporary magnet to work the stylus effectively. To meet this difficulty, Mr. Morse resorted to the simple device of employing a series of batteries distributed over his line of telegraphic communication, with as many shorter circuits, each operating, by means of a magnet at its extremity, to control the movements of a small lever, that opened or closed the circuit of the battery beyond. The last battery gave efficiency to the recording apparatus at the distant station. This formed the *combined series* of Mr. Morse's first patent.

It is easy to see, that the intermediate magnets of the combined series,

besides opening and closing the circuits, might be also made to act as recording magnets, by merely adapting to them the stylus with its appendages; and that there would thus be as many stations of telegraphic communication as there were batteries and minor circuits. But there still remained this objection to the combined series, that it could only be worked in one direction, and it was necessary therefore to have two complete lines of wires, with their batteries and magnets, in order to establish a reciprocating communication.

To dispense with this duplication of machinery and expense was the object of Mr. Morse, in the invention which is the subject of his second patent. It had been found that the magnetism excited by the electric coil was capable, at the end of an almost indefinitely extended circuit, of giving motion to a delicately adjusted lever, but that this was the apparent limit of its dynamic power. A single wire might be employed then, without intervening magnets, by connecting it at the extremities with electro-magnets, of great sensibility of mechanism, and employing the force of those magnets merely to open short local circuits, from which local circuits the degree of magnetic energy adequate to the purposes of the recording apparatus could be derived.

It is found, however, that the magnetism induced in soft iron by the electric current, though truly occasional, does not absolutely cease at the instant of breaking the circuit, but seems to linger in the iron for an appreciable interval of time afterwards, with an intensity, which, though slight, bears an apparent relation to the intensity of the current that induced it. This would interfere greatly with the very rapid operation of the telegraph, if the lever were left to withdraw itself from the magnet, to which it serves as armature, by the force of gravity alone. A small compensating spring is therefore connected with the machine, of sufficient strength to overcome the attraction of this lingering or continuous magnetic force, but not sufficient to resist the attraction of the magnet when the circuit is closed.

But the electric current after passing over a long wire, does not exert a uniform dynamic energy. However carefully insulated at first, the wire becomes, after a time, more or less exposed to atmospheric action, and the fluid is more or less dissipated in consequence. The posts, on which it is supported, become conductors during storms of rain, and carry off the fluid to the earth. Under other circumstances, the electro-magnetic phenomena are exaggerated at the receiving station by atmospheric electricity from the regions through which the conducting wire has passed. The batteries too do not always generate the fluid with the same rapidity. In a word, the current at the extremity of the circuit is irregular.

Now it is apparent, that under these varying states of the magnetic energy, the adjustment of the compensating spring at the receiving station must not be uniform. If its tension were just that which would neutralize or barely overcome the continuous magnetism induced by an electric current of small intensity, it would not draw back the armature when the inducing current had been in greater force; and on the other hand, a stronger spring, adapted to the case of a powerful current, would oppose a controlling resistance to the magnetism induced by a feeble one. The *Adjustable Receiving Magnet*, described in Mr. Morse's second patent,

meets perfectly the conditions of this difficulty, and enables the operator, by the mere touch of a finger on an adjusting screw, to regulate the tension of the spring, and adapt his apparatus to the circumstances of the moment.

The main line, thus arranged with its delicate receiving magnet and its short recording circuit at each extremity, made no provision for intermediate or collateral stations. But, as it had been found desirable in practice to distribute the batteries, in which the electric fluid was generated, over different parts of the line, so as to reinforce the energies of the current in its progress, it was almost an obvious suggestion to connect at these several points a receiving magnet of adjustable character, either with the main line, or with the battery forming part of it, and to attach to this receiving magnet a local registering circuit, or a branch circuit leading to one or more collateral stations.

Such I understand to be Mr. Morse's *Local or Independent Circuit.* His patent of 1846, as re-issued in 1848, claims it in these words:

"The employment in a certain telegraphic circuit, of a device or contrivance called the receiving magnet, in combination with a short local independent circuit or circuits, each having a register and registering magnet or other magnetic contrivances for registering, and sustaining such a relation to the registering magnet or other contrivances for registering, and to the length of circuit of telegraphic line, as will enable me to obtain, with the aid of a main galvanic battery and circuit and the intervention of a local battery and circuit, such motion or power for registering, as could not be obtained otherwise without the use of a much larger galvanic battery if at all."

That the local or independent circuit, as we have described it, and as it is more accurately and perhaps more intelligibly set out by Mr. Morse in his specification, was original with him, cannot be seriously questioned. The devices referred to in the patents of Cooke and Wheatstone, and Davy are at best imperfect modifications of the combined series of Mr. Morse's first patent; one of them not improbably borrowed from it. The adjustable receiving magnet, the indispensable and characteristic element of the local circuit patent, no one has claimed but himself.

It is only to make the first approach to a controversy on this point, to prove to us that Professor Henry had as early as 1828 made the *intensity magnet*, with which the scientific world is now familiar—or that he afterwards, and before Mr. Morse's first application for a patent, had illustrated before his classes at Princeton, the manner in which one circuit could operate to hold another closed or to break it at pleasure—or that he had foreseen the applicability of his discoveries to the purposes of a telegraph. The question is not one of scientific precedence; and if it were, this is not the forum that could add to or detract from the eminent fame of Mr. Henry. It is purely a question of invention applied in a practical form to a specific use; and so regarded it admits but of a single answer.

In passing from the questions of originality and identity of invention, that have been raised in the cause, without a more detailed review of all the testimony, there is occasion perhaps for an explanatory remark. It is this: the decree of a Judge finds its appropriate and only justification in the facts proved before him, not in theories, however ingenious, or the

less speculative inferences of other minds; and where the essential facts of a case are as clearly established as they are here, it would be unprofitable as well as painful perhaps to discuss the particulars of variance between the witnesses. There is no place in which the evidence of scientific men, upon topics within their own departments of knowledge, is more to be desired than in this Court, when sitting for the trial of patent causes; and the opinions also of such men, when duly supported by reasonings founded on ascertained fact, must of course be valued highly. But it is a mistake to suppose that even on a question of science, opinion can be dignified here or elsewhere with the mantle of authority. Still less can we allow it to avail us here, when it assumes contested facts, or volunteers to aid us in determining the import of written instruments.

These remarks are not dictated by a spirit of unkind or uncourteous commentary on the depositions before us. We know that when opinion is active, it is not always easy to limit its range. There is besides very much of accurate scientific history, and of just and well guarded deduction from it, in these two volumes of exhibits. But it must be confessed also, that there is to be found here and there not a little of imperfectly considered dogma, as well as something of doubtfully regulated memory —and it has seemed to us, in this case as well as in some others, that the toil and expense and excitement of litigation might have been moderated perhaps, if the appropriate tone and province of testimony had been more exactly understood by some of the witnesses.

The objections which have been taken to the terms of the re-issue of Mr. Morse's patent of 1846, may be answered by a simple reference to that part of our opinion, in which we have considered the arguments of the same character that were urged against the patent of 1840.

It is beyond controversy, that the Local Circuit Patent has been infringed upon at some of the stations of the respondents' line; and it is the opinion of the Court, that it is also violated whenever the Branch Circuit of Mr. Rogers is employed. We have not been able to see the asserted difference in principle between the two devices. Both are equally well described as Branch or as Local Circuits. They have the same purpose; they effect it by the same instrumentality, even in appearance, to a great degree; and they seem to vary only in this, that the one derives its electric fluid from a battery placed within the line of the main circuit, the other from a battery placed without it. The change may be for the better; or it may not:—if it be, it is patentable as an improvement; but it cannot be used without Mr. Morse's license, until after his patent has expired.

III. The third patent is for the Chemical Telegraph. We do not propose to enter on the discussion of this. The subject of it is clearly within the original patent of Mr. Morse, if we have correctly apprehended the legal interpretation and effect of that instrument. We will only say, that we do not hold it to have been invalidated by the decision of the learned Chief Justice of the District of Columbia on the question of interference. The forms of the two machines before him were not the same; and the leading principle of both having been already appropriated and secured by the Magnetic Telegraph patent of 1840, nothing remained but form, to be the subject of interference.

The counsel for the complainants will be pleased to prepare, for the consideration of the Court, the draft of a decree, in accordance with the prayer of their bill.

For the Journal of the Franklin Institute.

Remarks on the Propeller and Steam Engine of the War Steamer San Jacinto. *By* J. W. Nystrom.

As I have been kindly permitted in a few numbers of the Journal to express some of my ideas in relation to screw propellers, I will ask for room for the following: and I wish it to be distinctly understood by the readers of the Journal, that my remarks are not intended to be personal to Mr. Isherwood, but for the *interest of screw propelling steam navigation*, a subject which has received my sole attention for the last ten years.

In the article noticing the trial trip of the San Jacinto, on page 342, are two propellers, one four, and one six blades, which comparative proportions are, in my opinion, entirely opposite to what is proper for propelling.

If we take the pitch and length of the six bladed propeller, and give it to the four bladed one, and *vice versa*, give the pitch and length of the four bladed propeller to the propeller with six blades, they would make two well proportioned propellers.

In the article referred to, the number of blades is treated of as though it governed the slip, without any reference to what the number of blades depend on; we should rather say that *the slip governed the number of blades;* for instance, take a propeller 10 feet in diameter, with a proper pitch=25 feet, and length in the direction of the axis=4·5 feet, and make it with three blades; place this propeller on a vessel so proportioned that the slip will be about 30 per cent., and make an experiment; afterwards cut the propeller in two equal parts, by a plane at right angle to the axis, twist one of the two halves 60 degrees, we will have a six bladed propeller; or say we make a regular six bladed propeller with the same pitch and diameter as the one with three blades, but take only the length=2·25 feet; make another experiment with this six bladed propeller on the same vessel, we will obtain precisely the same result as with the three bladed propeller.

Again, let these two experiments be made on a larger or fuller vessel which causes a slip=40 per cent; we will find the three bladed propeller will make the best execution. Then let us make the two experiments on a smaller or sharper vessel, which causes a slip=20 per cent.; then we find the six bladed propeller to do best. Experiments that I know of, have been made with one two bladed, and one six bladed propeller; their lengths were carefully proportioned; the result from the two propellers were precisely alike; and the six bladed propeller has the advantage of taking up less room in the stern, and is stronger and safer.

The number of blades is also governed by the proportion of pitch and diameter. When the propeller is geared, a proper pitch is one and a half ($1\frac{1}{2}$), or twice (2) the diameter, according to the gear. In such instances the number of blades should not exceed four (4) for any slip.

The Scotch engineers take a very narrow pitch in proportion to the diameter; for instance, on the steamers City of Glasgow and City of Manchester, which propellers have three blades; but the pitch is not quite one and a half ($1\frac{1}{2}$) the diameter, when an American engineer would have taken the pitch two and a half ($2\frac{1}{2}$) the diameter; this makes considerable difference in the number of blades.

A formula or rules could be set up, but as there is seemingly so much obscurity regarding the *slip*, formula or rules would be of no use, but I hope there will come a time for them.

Slip.—Mr. Isherwood says, the slip on the propeller was 26·27 per cent. Is that possible? We challenge any chief engineer or propeller builder, to bring the slip down to 26·27 per cent. with a propeller of $14\frac{1}{2}$ diameter, and $42\frac{1}{2}$ pitch, the vessel being loaded to $15\frac{1}{2}$ feet draft of water.

Suppose the slip could be brought down to 26·27 per cent., there would be no difficulty in giving the propeller 50 revolutions per minute, then the speed will be

$$M=\frac{42{\cdot}5\times 50\times 0{\cdot}7373}{88}=17{\cdot}8 \text{ miles per hour.}$$

That is, from Halifax to Liverpool in

$$\frac{2508}{24\times 17{\cdot}8}=5{\cdot}78 \text{ days.}$$

Then we may hope to cross the Atlantic in less than 6 days. See page 322 about slip; this formula 2, will give the slip very near, when the propeller is about

$$P=2\tfrac{1}{2}D$$

But when the pitch varies much from this proportion, there must be another rule for calculating the slip, and will be very nearly as follows:

$$S=\frac{2{\cdot}5}{D^3}\sqrt{\pi^2 D^2+P^2}\,(\text{⊠}^2+2\sqrt[3]{Q^2})$$

For the meaning of letters see page 331.

When the San Jacinto is loaded to $15\frac{1}{2}$ feet draft of water, the displacement and greater section area will be about

⊠^{2}=429 square feet.
Q=1900 tons.
D=$14\frac{1}{2}$ feet.
P=$42\frac{1}{2}$ "

$$S=\frac{2{\cdot}5}{14{\cdot}5^3}\sqrt{3{\cdot}14^2\times 14{\cdot}5^2+42{\cdot}5^2}\,(429+2\sqrt[3]{1900^2})=37{\cdot}7$$

Or 38 per cent.

Which I think is the minimum slip of the propeller. If not taking the steam engine into consideration, there is entirely too much pitch on the propeller; but if the arrangement of the steam engine does not allow higher speed of the propeller, the only way to make it up is by the increased pitch; but I do not agree that the boilers cannot supply steam for less pitch and more revolutions. With less pitch the propeller runs easier, and there will be less slip, and the required quantity of steam will be precisely the same.

Mr. Isherwood says, that the slip is a measure of loss of effect; this is indeed an error. What loss of effect, then, should the American propellers have, compared with the Scotch propellers, as the slip of the former is 20 or 30 per cent. more than the slip of the latter, owing to the different proportions of pitch; but on a close examination of their performance, we will find the former is ahead of the said per centage in the economy of power.

But suppose the slip to be a measure of loss of power; then if there was no slip, there should be no loss of power, and if we finish the example per San Jacinto, we have the speed in statute miles per hour,

$$M=\frac{42{\cdot}5\times 31}{88}=15 \text{ miles per hour,}$$

but as there is no slip in the water, the propeller is of no use for propelling the vessel, it can as well be taken off, and the remainder will be 375.92 horse power, from the *steam engine, which will drive the vessel* 15 *miles per hour with no propeller! ! !*

However, the loss of effect by slip should not be taken off from the total power developed by the steam. First, take off the per centage for all the frictions and working the pumps, and from the remainder, as a unity, take off the per centage for slip. Suppose all the frictions and working the pumps to be about 35 per cent, we have, per San Jacinto, $782\times 0{\cdot}35=274$ horses, and $782-274=508$ actual horse power to propel the vessel; from that we take the per centage for the slip, or, $508\times 0{\cdot}26=132$ horses which should be the loss of effect by slip, and $508-132=376$ horses, the useful effect which propells the vessel.

Friction and working the pumps, ...	=274 horses.
Loss by slip, ...	=132 "
Useful effect, ...	=376 "
Total effect from the steam,	=782

That is, if the slip was only 26 per cent; if the slip is 38 per cent. the loss of effect should be $508\times 0{\cdot}38=193$ horses, and useful effect only $508-193=315$ horses.

For the Journal of the Franklin Institute.

Trial Trip of the Steamer La Guayra. *By* B. F. Isherwood, *Chief Engineer U. S. Navy.*

A small sea steamer intended to ply as a packet between La Guayra, South America, and the West India Island of St. Thomas, has recently been constructed at Baltimore, by Murray & Hazlehurst. At her late trial trip in Chesapeake Bay, the following results were obtained:

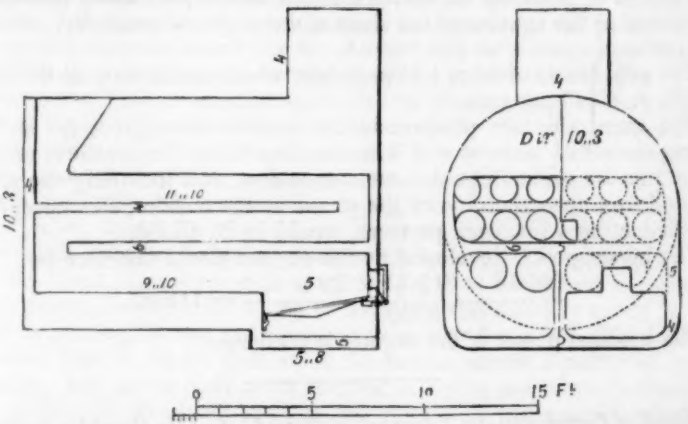
Hull.—Length on deck 132 feet, between perpendiculars 130 feet; breadth of beam 21 feet, over guards 34 feet; depth of hold 9 feet; burthen 250 tons; rigged as a three-masted schooner; draft forward $7\frac{1}{2}$ feet, aft 7 feet.

Engines.—Two steeple engines, with four piston rods each. The advantage of this form of steeple engine over that with one piston rod, consists

in allowing the crank to revolve within a few lines of the cylinder head; when one piston rod only is used, a cross head interposes between crank and cylinder head. Weight of engines, 75,741 lbs. Diameter of engines, 28 inches; stroke of piston, 4 feet; space displacement of both pistons per stroke, 34·208 cubic feet. There is one double acting air pump to both engines: diameter, 18⅝ inches; stroke of piston, 2 feet; space displacement of piston per stroke, 3784 cubic feet, or 1000 to every 9014 cubic feet of steam pistons' displacement. Steam valve, a long equilibrium slide.

Paddle Wheels.—Of the common radial kind, 15¾ feet diameter. — paddles in each wheel; each paddle 5½ feet long by 18 inches broad. Dip of paddles, 30 inches.

Boilers.—One iron boiler, 15½ feet long, 10¼ feet wide, and 11 feet high; containing 46·25 square feet of grate and 1010 square feet of heating surface. Weight of boiler, 31,779 lbs. The boiler has double return ascending flues; 4 lower flues, 2 of 19 and 2 of 21 inches diameter. First return 6 flues, 16 inches diameter; second return 6 flues, 15½ inches diameter. Area of lower flues, 8·749 square feet; of first return flues, 8·377 square feet; of second return flues, 7·904 square feet; of smoke pipe, 10·559 feet. Diameter of smoke pipe, 3⅔ feet; height above grates, 44 feet. Proportion of heating to grate surface, 21·838 to 1·000. Proportion of least calorimeter to grate surface, 1·000 to 5·851.



This boiler supplied the cylinders with 60 charges of steam per minute, of 20 pounds boiler pressure above the atmosphere, cutting off at ⅖ths the stroke from the commencement; consuming 747 lbs. of bituminous coal per hour.

The space displacement of both pistons being 34·208 cubic feet, and the steam being admitted into ⅖ths of this space before cutting off, or filling 21·38 cubic feet, to which add 0·62 cubic feet for clearance and nozzles, &c., making 22 cubic feet of steam used per stroke, and as the pistons make 60 strokes per minute, there would be used per hour 79,200 cubic feet of steam. Taking the steam pressure in the cylinders at 1·7 lb.

less than in the boiler, the total initial pressure in the cylinders would be 33 lbs.; and as the bulk of steam of that pressure to the water from which it is generated is as 810 to 1, there would be evaporated (79200 ÷ 810) 97·78 cubic feet of water. Taking the cubic foot of water at 64·3 lbs., there would be evaporated 6287·25 lbs. of sea water by 747 lbs. of bituminous coal, or 8·417 pounds of water per pound of coal. The trial trip was of so short duration, that there was no loss by "blowing off" to estimate for.

There was burned per hour per square foot of grate surface, 16.15 lbs. of coal; and there were evaporated per hour per square foot of heating surface, 6·223 lbs. of sea water.

Performance.—The vessel being brought to a draft of 7½ feet forward and 7 feet aft, the immersion of the lower edge of the paddles being 30 inches, made, with 30 revolutions of the wheels, 11½ statute miles per hour, in Chesapeake Bay. Steam pressure in boiler, 20 lbs. per square inch, cutting off at ⅝ths the stroke from the commencement.

The centre of reaction of the paddles moves through a space of 46·5 feet per revolution; the slip of the paddles will therefore be as follows:

46·5 × 30 × 60 = 83700 feet = speed of centre of reaction of paddles per hour.
5280 × 11½ = 60720 " = speed of vessel per hour.

22980 " = slip of centre of reaction of paddles per hour,

or 27·45 per cent.

The loss of labor by the oblique action of the paddles on the water, calculated as the squares of the sines of the angles of incidence, is 15·98 per cent.

The total losses of labor by the paddle wheel would then be 27·45 + 15·98, or 43·43 per cent.

The mean effective pressure in the cylinder throughout the stroke, taking the initial pressure at 1·7 lb. less than the boiler pressure, cutting off at ⅝ths the stroke from the commencement, and including the effect derived from the expansion of the steam in the nozzles, clearance, &c., and deducting 4 lbs. back pressure, would be 26·48 lbs.

The horses power developed by the engines would therefore be

$$\frac{(26{\cdot}48 \times 615{\cdot}75 \times 30 \times 4)\,2}{33000} = 118{\cdot}58.$$

The nominal power of the engines is 60 horses.

A Series of Lectures on the Telegraph, delivered before the Franklin Institute. Session, 1850–51. *By* Dr. L. Turnbull.

Continued from page 339.

Dr. Steinheil's Magnetic Telegraph.

This telegraph is composed of three principal parts. 1, A metallic connexion between the stations. 2, The apparatus for exciting the galvanic current. 3, The indicator.

1. *Connecting Wire.*—The so called connecting wire may be looked on as the wire completing the circuit of a voltaic battery extended to a very great length. What applies to the one holds good of the other. With

equal thicknesses of the same metal, the resistance offered to the passage of the galvanic current is proportional to the length of the wire. With equal lengths of the same metal, however, the resistance diminishes inversely with the section; but the conducting power of metals is very different. According to Fechner, copper conducts six times better than iron, and four times better than brass. The conducting power of lead is even lower, so that the only metals which can well vie with each other in their technical use are copper and iron. But now, though iron is about six limes as cheap as copper, it will be requisite to give the iron wire six times the weight of a copper one, to gain the same conducting power with equal lengths. We thus see, that as far as the expense is concerned, it comes to the same thing whichever of these metals is chosen. The preference will, however, be given to copper, as this metal is less liable to oxidization from exposure to the atmosphere. This latter difficulty may nevertheless be surmounted by simple means, namely, by galvanising it. It would even appear that the simple transmission of the galvanic current when the telegraph is in use, is sufficient to preserve the iron from rust; such at least is observed to be the case with the iron portion of the wire used for the telegraph here, and which has already been exposed in all weathers.

If the galvanic current is to traverse the entire metallic circuit without any diminution of intensity, the wire during its whole course must not be allowed to come into contact with itself; neither should it be in frequent contact with semi-conductors, inasmuch as a portion of the power called into action takes its course by the shortest way in consequence thereof, whereby the remotest parts are deprived of a portion of the power.

Numerous trials to insulate wires, and to conduct them below the surface of the ground, have led me to the conviction that such attempts can never answer at great distances, inasmuch as our most perfect insulators are at best but very bad conductors. And since in a wire of very great length, the surface in contact with the so-called insulator is uncommonly large, when compared with the section of the metallic conductor, there necessarily arises a gradual diminution of the force, inasmuch as the out and the home wire, although but slightly, yet *do* communicate in intermediate points. It would be wrong to think that this difficulty would be got over by placing the out and the home wire very far apart. The distance between them is, as we shall see in the sequel, almost a matter of indifference. And as we shall never succeed in laying down conductors that are sufficiently insulated beneath the surface of the ground, which is always damp, there is but one other course open to us, namely, leading the wire through the air. Upon this plan, it is true, the conductor must be supported from time to time; it is liable to be injured by the evil disposed, and is apt to suffer from violent storms, or from ice which forms upon it. As we, however, have no other method that we can avail ourselves of, we must endeavor by suitable arrangements to get the better of these, not immaterial, faults in the best way that we can.

The conducting chain of the telegraph erected here, consists of three parts: one leads from the Royal Academy to the Royal Observatory, at Bogenhausen, and back, and the total length of its wire is 32,506 feet. The weight of the copper wire employed amounts to 260 pounds. Both

wires (there and back) are stretched across the steeples of the town, at a distance of four feet one inch. The greatest distance from support to support is 1279 feet: this is undoubtedly far too great for a single wire, inasmuch as the ice that forms upon it materially increases the weight of the wire itself, and considerably augments its diameter, so that it thus becomes liable to be torn asunder by high winds. Over those places where there are no high buildings, the connecting wire is supported upon tall poles forty or fifty feet long, which are let five feet into the ground, and to the top of which the wire is fastened to a cross bar. At the point where the metal rests there is simply a piece of felt laid, and the wire is made fast by twisting it round the wooden bar. The distance from pole to pole ranges between 640 and 650 feet; but this is far too great, for experience has shown that the wires become considerably stretched by high winds and other causes, and have, in consequence, had to be taken up more than once. All these evils would be got over by making the connexion by at least a triple strand of metal, and not by a single wire, supporting it at intervals of 300 feet, and giving it a tension not exceeding one-third of what it will bear without giving way. This, however, in the experimental telegraph erected here, was not practicable, for reasons into which we cannot enter.

The conducting wire thus mounted, is by no means completely insulated. When, for example, the circuit is broken at Bogenhausen, an induction shock given in Munich ought to produce no galvanic excitation whatever in the parts of the chain then disconnected. Gauss's galvanometer, however, even then gives indication of a weak current; measurements indeed go to show that this current goes on increasing as the point at which the interruption of the stream is made recedes from the inductor. The absolute amount of this current is not constant. Generally it is strongest when the weather is damp. When there are heavy showers of rain, it may be fairly said to be five times as strong as when the weather is settled dry. At moderate distances of a few miles, this small loss of power is of almost no importance, and that the more as the construction of the inductor places currents of almost any strength we choose at our command. When the distance, however, amounted to upwards of 200 miles, the greatest part of the effect would be dissipated. In such cases much greater precaution must be taken with regard to the points of support of the metallic circuit.

When thunder storms occur, atmospheric electricity collects on this semi-insulated chain as upon a conductor, but the passage of the galvanic current is not at all affected thereby. An occurrence may be mentioned here as a warning for the future. During a severe thunder storm on the 7th July, 1838, a very strong electric spark darted at the same instant through the entire conducting chain, and there was simultaneously produced at the indicator, that is fitted up in my room, a sound like the cracking of a whip. At the same time the lower toned bell of the indicator emitted a sound owing to the deflexion of the needle, and the blow was so hard that the points on which the magnetic bar plays were injured. The same phenomenon was observed also at one of the other stations. As the deflecting power of frictional electricity is very inconsiderable with respect to magnets, the above occurrence indicates the presence of a

vast quantity of electricity. It can only have arisen from the electricity of the earth having at that moment made its way to that collected in the wire. Whether this was brought about through the lightning conductors in the neighborhood, or the imperfect insulation of the points of support, cannot be well made out.

Quite recently I made the discovery, that the ground may be employed as one-half of the connecting chain. As in the case of frictional electricity, water or the ground may with the galvanic current form a portion of the connecting wire. Owing to the low conducting power of these bodies, compared with metals, it is necessary that at the two places where the metal conductor is in connexion with the semi-conductor, the former should present very large surfaces of contact. Taking water, for instance, to conduct two million times worse than copper, a surface of water proportional to this must be brought in contact with the copper, to enable the galvanic current to meet with equal resistance, in equal distances of water and of metal. For instance, if the section of a copper wire is 0·5 of a square line, it will require a copper plate of 61 square feet surface in order to conduct the galvanic current through the ground, as the wire in question would conduct it. But as the thickness of the metal is quite immaterial in this case, it will be always within our reach to get the requisite surfaces of contact at no great expense. Not only do we by this means save half the conducting wire, but we can even reduce the resistance of the ground below what that of the wire would be, as have been fully established by experiments made here with the experimental telegraph.

A second portion of the conducting chain leads from the Royal Academy to my house and observatory in the Lerchenstrasse. This conductor is of iron wire; its length, there and back, is 5745 feet, and it is stretched over steeples and other high buildings, as has already been described. Lastly, a third portion of the chain, running through the interior of the buildings connected with the Royal Academy, leads to the mechanical workshop attached to the cabinet of Natural Philosophy. It is composed of a fine copper wire, 958 feet long, let into the joinings of the floor, and in part imbedded in the walls. These three portions together compose a line, returning into itself, and into which the apparatus for generating the galvanic current, and also the indicator, are inserted.

2. *Apparatus for Generating the Galvanic Current.*—Hydro-galvanism, or the galvanic current generated by the action of the voltaic pile, is by no means fitted for traversing *very long* connecting wires, because the resistance in the pile, even when many hundred pairs of plates are employed, would be always inconsiderable compared with the resistance offered by the wire itself.

The principal disadvantage, however, attendant on the use of the pile or trough apparatus, is the fluctuations of their current, joined to the circumstance of their becoming very soon quite powerless, and requiring to be taken to pieces and put together again. The extremely ingenious arrangement of Morse is likewise subject to this inconvenience. (All these inconveniences have been obviated by Morse's local circuit and the improved form of battery employed since Steinheil's experiments.—T.) All this, however, is got over when one, to generate the current, has recourse to Faraday's important discovery of induction, that is to say, by moving

magnets placed in the neighborhood of conducting wires. The better way, however, is, not to move the magnets as Pixii does in his electro-magnetic apparatus, but rather to give motion to the multipliers placed close to a fixed magnet. The arrangement that Clarke has given to the multiplier is the one which, with some modifications, has been adopted. Assuming on the part of our readers a general knowledge of the principles of the apparatus, we here confine ourselves to explaining how it has been adapted to purposes of telegraphic intercourse.

The magnet is composed of 17 horse-shoe bars of hardened steel. With its iron armature its weight is about 74 lbs., and it is capable of supporting about 370 lbs. Between the arms of the magnet there is fastened a piece of metal, supporting in its centre a cup provided with adjusting screws, and which serves as a support for the axis of the coils of the multiplier. The coils of the multiplier have in all 15,000 turns of wire. A metre (3 feet 3·3708 inches English) of this wire weighs 15½ grains, and it is twice bespun with silk. Its two ends, which are insulated, are passed up through the interior of the vertical axis of the multiplier, and then terminate in two hook-shaped pieces, as may be seen in Plate xv. figs. 8 and 9. In order to secure perfect insulation, the vertical axis, fig. 8, was bored out hollow. Into this hole there are let in from above two semicircular rods of copper, which are prevented touching by a strip of taffeta fastened between them with glue; and these again are kept from touching the metallic axis by winding taffeta round them. In each of these little strips of metal there is, above and below, a female screw cut. In the lower holes small metal pins are screwed in, to which the ends of the multiplier are soldered securely on. While in the upper holes, as may be seen distinctly in figs. 9 and 10, there are iron hooks screwed in. These hooks therefore form the terminations of the multiplier wires of the coils of the inductor. They here turn down, fig. 15, into two semicircular cups of quicksilver, that are separated by a wooden partition. From these cups of quicksilver there proceed connexions, J J, figs. 8 and 13, towards the wires, and they therefore may be considered as forming part of the chain. The quicksilver, owing to its capillarity, stands at a higher level in these semicircular cups than are the partitions, so that the terminal hooks of the wires of the multiplier pass over these partitions without touching them when the multiplier is made to turn on its axis. One sees that the hooks thus are brought into other cups of quicksilver at every half turn of the multiplier, in consequence of which the galvanic current preserves its sign as long as the multiplier is turned in one direction, but it changes its sign on the motion being reversed. This commutation, which it may be remarked may be established without the use of mercury, by the contact of strips of copper that act like springs, is found to answer completely. There are besides two other arrangements which we must not allow to pass unnoticed.

The galvanic current, as we shall see in the sequel when treating of the indicator, should only be permitted to be in action during as short a period as possible, but during that interval should have the greatest intensity we can command. The terminal hooks of the wires dip into the quicksilver only at the place where it forms pools that advance towards each other at the centre, and where the current is at its greatest intensity,

see figs. 13, 14, and 15. Fig. 15 shows the position that the inductor has when the terminal hooks first dip into the cups. In all other positions of the inductor it should however form no part of the chain, otherwise the signals made at the other stations will be repeated by its own multiplying wire; and this becomes of the more moment the greater the resistance in the inductor is. In order therefore to cut off the inductor when in any other position than shown at fig. 15, there is a wooden ring adapted to the axis of rotation of the inductor, see figs. 11 and 12. This ring is encircled with a copper hoop, and into this latter two iron hooks are screwed. These hooks dip down into the semicircular cups of quicksilver, as shown at fig. 14. At the moment, however, that they are passing across the wooden partition, the hooks of the inductor, which are at right angles to them, dip into the cups. When the hooks of the multiplier are in contact with the quicksilver, the connexion with the hooks for diverting the current is broken. In every other position the connexion through the hooks of the multiplier is interrupted, while it is established through the others; whence it naturally follows that the current, on being transmitted from any other station, passes directly through the latter hooks, or, in other words, crosses directly from one quicksilver cup to the other, and is not forced to traverse the wire of the inductor for that purpose. In order to put the inductor in motion without trouble, there is a fly bar terminating in two metal balls fastened horizontally on to its vertical axis, (annexed cuts,) figs. 39 and 40. To prevent the quicksilver being scattered about, owing to the motion of the hooks as they dip into it when the multiplier is turning rapidly, a glass cylinder is fitted on to this part of the apparatus, fig. 1. At every half turn is seen the passage of the spark, as the hooks of the multiplier leave their cups of quicksilver.

Fig. 39.

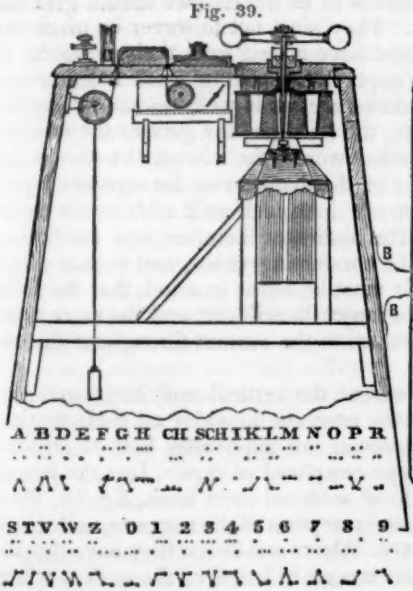
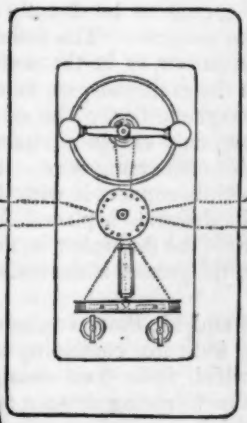


Fig. 40.



Lines.

If we choose to give up the phenomena of these sparks, a thing noways necessary to the employment of the instrument as a telegraph, the inductor will admit of a far more simple construction. It will then merely be necessary to place the commutator directly above the anker, and to let the axis of rotation pass farther up in the neck, in the direction of the fly bar. It then becomes unnecessary to bore the axis out, but the ends of the multiplier are at once fastened by twisting on to two plates of copper, and these copper plates are let into a wooden ring directly opposite each other. The wooden ring is placed upon the vertical axis, and made fast to it by clamps. Externally this ring is, in addition to the above-mentioned plates, provided with an arc of copper let into it, which acts as a contact-breaker, and two ends of the chain that the current has to traverse have the form of permanent springs, that keep pressing against the wooden rings directly opposite each other. By this means, with this arrangement also, the ends of the inductor are in metallic communication with the chain only during a small portion of each revolution, while during the rest of the time the connecting arc brings the ends of the chain into direct contact. This construction, in which quicksilver is entirely dispensed with, is, on account of its greater simplicity and durability, preferable to the arrangement first described. The apparatus of the stations at Bogenhausen and in the Lerchenstrasse are thus constructed.

3. *The Indicator.*—We have shown in the preceding paper, that our aim is so to employ the current developed by the inductor and led through the conducting chain, that when passed across magnetic bars that are delicately suspended, it may cause them to be deflected, as was discovered by Œrsted. These deflexions, if we wish to give the signals in quick succession, must follow each other with the greatest rapidity, and should therefore be powerful. This points out to us the size we should give the magnetic bars we wish to deflect. They must not however be made too small, as in that case the mechanical force arising from their deflexion is not strong enough to be directly applied to striking upon bells, or any other similar purpose. The deflexions are, as is well known, taking the force of the current to be the same, the stronger, the greater the number of turns in the multiplier, or, in other words, the oftener the wire is led along the magnetic bar. The size of the diameter of the separate turns, as we know, only exerts an influence inasmuch as it adds to the entire length of the connecting wire. The indicator therefore is a multiplier, whose two ends connect it with the conducting chain, and within which the bar to be deflected is placed. It must be borne in mind, that the thinner the wire of the multiplier is, the larger its coils are; and the more turns they make, the greater is the resistance to the current throughout the entire chain.

Figs. 16 and 17, Plate xv., represent the vertical and horizontal sections of an indicator containing two magnets, movable on their vertical axis, and which from their construction are applicable both to striking bells and also to noting down a type composed of dots. Into the frames of the multiplier, which are made of soldered sheet brass, fig. 16, there are soldered two smaller cases for the reception of the magnets, and which allow of the free motion of their axes. Above and below they have threads cut in them for the reception of four screws in holes, on the ends of which

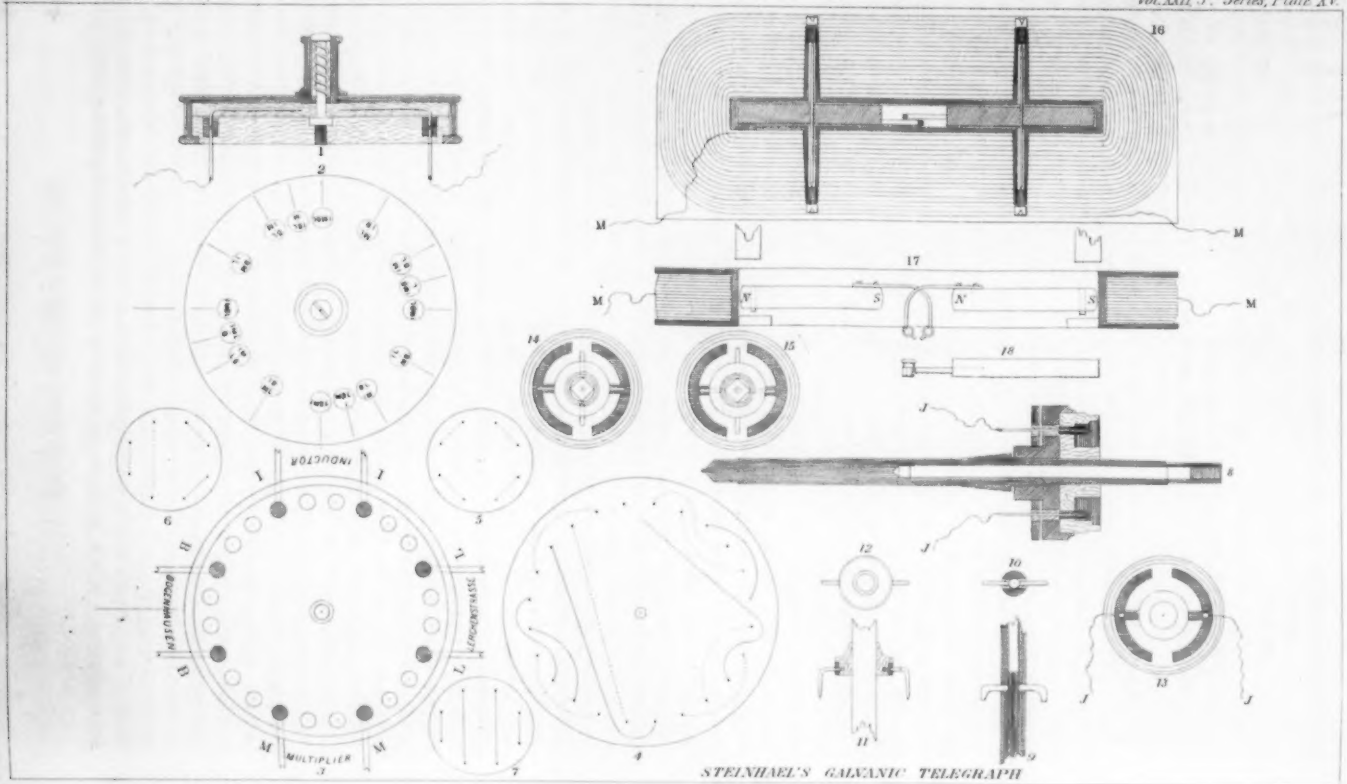
the pivots of the axes turn. By means of these screws the position of the bars may be so regulated that their motion is perfectly easy and free. In the frames of the multiplier there are 600 turns of the same insulated copper wire as was employed for the inductor. The commencement and the end of this wire are shown at M M, fig. 16. The magnetic bars are, as the figure shows, so situated in the frame of the multiplier, that the north pole of the one is presented to the south pole of the other. To the ends which are thus presented to each other, but which, owing to the influence they mutually exert, cannot well be brought nearer, there are screwed on two slight brass arms supporting little cups, figs. 17 and 18. These little cups, which are meant to be filled with printing ink, are provided with extremely fine perforated beaks that are rounded off in front. When printing ink is put into these cups, it insinuates itself into the tube of these beaks, owing to capillary attraction; and without running out forms at their apertures a projection of a semi-globular shape. The slightest contact suffices therefore for noting down a black dot. When the galvanic influence is transmitted through the multiplying wire of this indicator, both magnetic bars make an effort to turn in a similar direction upon their vertical axes. One of the cups of ink would therefore advance from within the frame of the multiplier, while the other would retire within it. To prevent this, two plates are fastened at the opposite ends of the free space that is allowed for the play of the bars, and against which the other ends of these bars press. Only the end of one bar can therefore start out from within the multiplier at a time, the other being retained in its place. In order to bring the magnetic bars back to their original position as soon as the deflexion is completed, recourse is had to small movable magnets, whose distance and position is to be varied till they produce the desired effect. This position must be determined by experiment, inasmuch as it depends upon the intensity of the current called into play.

If this apparatus be employed for producing two sounds easily distinguishable to the ear by striking on bells, it will be right to select clock bells or bells of glass, both of which easily emit a sound, and whose notes differ about a sixth. This interval is by no means a matter of indifference. The sixth is more easily distinguished than any other interval; fifths and octaves would be frequently confounded by those not versed in such matters. The bells are to be supported on little pillars with feet, and their position with respect to the bars, and likewise their distance from them, is to be determined by experiment. The knobs let into the bar that strike on the bells must give the blow at the place which most easily emits a sound. These hammers, however, are not to be too close to the bells, as in that case a repetition of the signal can easily ensue. A few trials will soon get over this difficulty. If the indicator is to write down the signals, a flat surface of paper must be kept moving with a uniform velocity in front of the little beaks above mentioned. The best way of doing this is to employ very long strips of the so-called endless paper, which is to be wound round a cylinder of wood, and then cut upon the lathe into bands of the suitable width. One of these strips of paper must be made to unwind itself from a cylinder, pass close in front of the cups, run along a certain distance in a horizontal position, so that the dots noted down may be read off, and lastly, wind itself up again on to a second cylin-

der. This second cylinder is put in motion by clock work, the regularity of whose action is insured by a centrifugal fly-wheel. A longitudinal section of the entire arrangement is shown at fig. 39, (p. 411.) Fig. 40 represents it as seen from above. At the corners of the frame over which the ribbon of paper is led, there are placed two movable rollers, to diminish the friction. This frame moreover admits of being advanced towards the cups or withdrawn from them, so that the most proper position to give it can be ascertained by experiment. It is evident that the same magnetic bars cannot be at once employed for striking bells and for writing, the little power they exert being already exhausted by either of these operations. But to combine them both, all we have to do is to introduce a second indicator into the chain. By thus increasing the number of the indicators, the loudness of the sounds of the bells can be augmented at pleasure; this can, however, only be done at the cost of an increased resistance in the chain. In order that this may be increased by the indicator as little as possible, it would in future be better that its coils should be made of very thick copper wire, or of strips of copper plate.

The above description will enable those who are familiar with such subjects to construct the apparatus for themselves. We have yet to add a few words upon

The Way of putting the Apparatus together.—Fig. 39, (p 411,) represents the longitudinal section of a pyramidal table, standing on the floor of the room, and containing the whole apparatus. Fig. 40 shows the same as seen from above. The wires from Bogenhausen, those from the Lerchenstrasse, the ends of the indicator, and the wires from the quicksilver cups of the inductor, or, in other words, the two ends of its multiplier, all meet together at the centre of the table, as seen at fig. 40. They are here brought into connexion with eight holes filled with quicksilver, made in a disk of wood, as shown at fig. 3, Plate xv. The course that the current we call forth will take depends upon the respective connexion of these eight holes with each other. For instance, supposing them to be connected together by four pieces of bent copper wire, as shown at fig. 3, the current would pass through the whole apparatus, and also the entire chain. Establishing, however, the connexion as shown at fig. 6, would cut off the Bogenhausen station, and would at once transmit the current direct from the inductor, through the multiplier of the indicator and through the Lerchenstrasse station. Supposing this figure turned round 180 degrees, we should have the Lerchenstrasse station cut off, and the current would pass through Bogenhausen. A third system of connexions is shown by the copper wires represented in fig. 7. In this position of the sketch, the inductor and the multiplier would be in direct communication, while the two stations at Bogenhausen and in the Lerchenstrasse would be cut off. But by turning this figure 90 degrees, we should connect these two stations, while we broke off the station in the Academy. Copper wires, serving to establish these three systems of connexion and the combinations, are laid down upon the under surface of the wooden cover of the commutator, as seen at fig. 4. There are 24 wires projecting downwards from this lid. Only eight of them, however, ever come into use at once, so that there must be sixteen other holes made in the lower disk of wood, for the reception of the wires not in use, and having no quicksilver



STEINHAEL'S GALVANIC TELEGRAPH

poured into them. It is thus in our power to direct the course of the current as we choose, and the systems concerned are indicated upon the upper surface of the cover of the commutator by engraved letters, see fig. 2, Plate xv.; this cover containing the different modifications of the systems of connexion, as shown at fig. 4. Changing the position of this cover round the central pin springing from the table, enables us to vary the direction of the current in any manner we like. The use of quicksilver cups in the commutator may of course be replaced by conically turned copper pins. This has indeed been done at the Lerchenstrasse and the Bogenhausen stations.

We shall conclude by a few remarks upon

The Application of this Apparatus to Telegraphic Communication.—We know from what has preceded, that at every half turn of the fly-bar from right to left, one of the bars is deflected. I have so connected the terminations of the wires, that every time this movement is repeated the high toned bell should be struck at all the stations. Standing at the side B B, and turned towards the indicator, one immediately perceives the beak imprint a dot upon the ribbon of paper as it moves along. The intervals of time between the successive repetitions of this sign, are represented by the respective distances between the dots that follow in a line upon the paper. On turning the fly-bar from left to right towards the operator, the deep toned bells ring, and the second ink cup marks down a dot upon the paper as before; not, however, upon the same line with the former dots, but upon a lower one. *High* tones are therefore represented by the *upper* dots, and *low* tones by the dots of the *lower* line, as in writing music. As long as the intervals between the separate signs remain equal, they are to be taken together as a connected group, whether they be pauses between the tones, or intervals between the dots marked down. A longer pause separates these groups distinctly from each other. We are thus enabled, by appropriately selected groups thus combined, to form systems representing the letters of the alphabet or stenographic characters, and thereby to repeat and render permanent at all parts of the chain, where an apparatus like that above described is inserted, any information that we transmit. The alphabet that I have chosen represents the letters that occur the oftenest in German by the simplest signs. By the similarity of shape between these signs and that of the Roman letters, they become impressed upon the memory without difficulty. The distribution of the letters and numbers into groups consisting of not more than four dots, is shown at fig. 39, (page 411.)

On the Explosion of the Locomotive "Minnesota," on the Philadelphia and Reading Rail Road.

"DEAR ——: "*Reading, Pa., October* 27, 1851.

"In reply to your favor of the 24th inst., I would state,

1st. It is impossible to say, with certainty, what was the height of the water at the instant of giving way of the crown sheet.

The engine "Minnesota" was in charge of a very good and careful man, who states that he had *shut off his pump* a short time previously, when going down grade, after having found water in his top cocks; upon which point he is positive.

2d. In contradiction to the above statement, there are some indications of the crown sheet and top row of tubes having been very hot, from the present appearance of both; but what degree of heat had been reached it is difficult to say.

3d and 4th. No bridge bars were used, stay bolts being inserted in their place, fig. 1 being the form of the firebox.

Fig. 1.

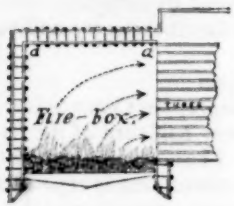
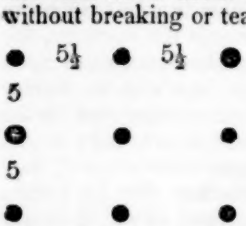


Fig. 2.

The lower crown sheet, from *d* to *a*, gave way, by stripping the screw threads and rivet heads of all the stay bolts between it and the top sheet, and sank down about two to three inches, forming a dish, as in fig. 2, without breaking or tearing in the least the boiler iron, which is of excellent quality. The stay bolts are ¾-in. round iron, and are from 5 to 5½ inches apart, fig. 3; water way between crown sheets 4 inches. I think the explosion was caused by a combination of these causes; too great a distance between the stay bolts for proper strength; the under heads of the stay bolts not being sufficiently riveted, and the heating of the crown sheet, from low water in the boiler.



The engine is now at Reading, but is uninjured except as described, in the sinking of the crown sheet. It is but eleven months old, and has run but 18,000 miles. It was built by Ross Winans, of Baltimore, and weighs 22½ tons of 2240 lbs., with coal fuel and water.

The engine emptied itself of the water and steam in the boiler through the stay bolt holes in the lower crown sheet, instantly killing the fireman, who was standing opposite the fire doors, and slightly scalding one of the brakemen, on the tender, who was just in the act of getting off the engine.

For the Journal of the Franklin Institute.

On Holophotal Lights for Light-Houses. By Thomas Stevenson, Esq., *Civil Engineer.*

Observing from some parts of the transactions of the Franklin Institute which were sent to me last month, that a Member brought forward at the meeting on 20th December, 1849, a claim for the invention of my Holophotal prisms for Light-Houses, I beg leave to bring the following facts under notice:

1st, I communicated my invention to the Secretary of the Royal Scottish Society of Arts, on the 30th March, 1849, and in proof of the due receipt of the communication, I received from the Secretary an acknowledgment, of which the subjoined is a copy:

"Edinburgh, March 31, 1849.

"Thomas Stevenson, Esq., C. E.

"DEAR SIR:—I have received your letter of 30th inst. with another tracing of a form of light, in which catadioptric zones are employed for parallelizing the diverging rays, both horizontally and vertically.

"I presume you are not yet ready with the models, so that you do not wish your papers read, till you give me further notice.

"Yours, very truly,

(Signed,) "JAMES TOD, Sec'y R. S. S. A."

2d, On the 30th April, 1849, I described at a public meeting of the Royal Scotch Society of Arts, the invention among several others, and in particular, along with my description of the Holophotal system generally.

3d, On the 15th of October, 1849, the proceedings of the Society at the meeting above referred to, were published in the Edinburgh Evening Courant Newspaper, from which I have extracted the following minute:

"Another new form of Light-house apparatus was also described, by which the whole sphere of rays can be parallelized by means of a hemispherical reflector placed behind the light, and an annular lens, and a series of concentric totally reflecting glass zones, also placed in front, and receding from the lens back to the reflector. These zones are also new in themselves, as they have the property of parallelizing divergent rays, not only in a vertical plane like the zones in Fresnels fixed lights, but also in every plane whatever."

About the same time it appeared, to my own knowledge, in the Practical Mechanics' Journal, and the Civil Engineer and Architect's Journal of November, 1849.

4th, In Mr. Alan Stevenson's rudimentary practice, (one of Mr. Weale's series which was published Dec. 21st, 1849, there is *inter alia*, a description of the Holophotal prisms.

5th, In July, 1850, a complete set of rings on this principle, 23·2 inches in diameter, were shown lighted in the Assembly Rooms, Edinburgh, at a Conversazione of the British Association, which met at Edinburgh that year.

6th, The Light of Pedra Branco, near Singapore, has been fitted up with nine Holophotal Reflectors, in which the prisms were placed; and also the Harbor Light at Pultneytown, in Caithnesshire, which was lighted on 21st July last.

From these facts you will observe that the priority of the invention of these prisms belongs to me, and that my account of them was brought before the public at a meeting of the Royal Scottish Society of Arts, nearly eight months before the date of your meeting. I have, therefore, to request that you will bring this communication under the notice of the Institute at your early convenience.

Edinburgh, October 15, 1851.

For the Journal of the Franklin Institute.

Experiments upon two Hydraulic Motors, with Prony's Friction Brake, showing the comparative power between an Over-shot Wheel and a Jonval Turbine, made for Troy, N. Y., by Mr. E. GEYELIN.

1st. *Experiment upon an Over-shot Wheel.*—Head and fall, 27 feet; number of revolutions of shaft where the friction brake was applied, 80.

Total weight on lever,	331·50	
Weights raised including the lever,		366·00
Weight of lever,		34·50
		331·50

Circumference of lever, 71·47 feet. Result 57·84 horse power.

2d. *Experiment upon a Jonval Turbine.*—Head and fall, 19 feet 1½ inches; number of revolutions of shaft where the friction brake was applied, 196.

Weight raised,		46·50 lbs.
Weight of lever,		34.50 "
Part cut off at the end of arm,		1·00 "
	Total weight,	82·00

Circumference of lever, 71·47 feet. Result, 34·81 horse power.

Power transmitted by a 25 feet diameter over-shot wheel, with a fall of 27 feet, to a shaft running at speed of 80 revolutions, (to which the brake was applied,) 57·48 horse power.

Estimated loss of effective power on increasing the speed from 80 to 180 revolutions, 2·48 horse power,	57·48	
	2·48	
Power transmitted to the rollers of the engines,		55·00 horse power.
As the overshot wheel is supposed to have been overloaded, I add to it five per cent of its effective power, to bring it into its best condition, or, 2.75 horse power; making the total power of the overshot wheel in its best condition, with the rollers run. at a speed of 180 rev.,	2·75	57·75 horse power.

By actual experiment the effect of an overshot wheel, using the same quantity of water, diminishes in the ratio from one to one-third, when the fall diminishes from one to one-half.

If an over-shot wheel 25 feet diameter gives		57·75 horse power,
One of	12·5 feet diameter will give	19·25 "
	37·5 feet.	77·00

An overshot wheel of 18·75 feet diameter, gives 38·50 horse power; if, therefore, an over-shot wheel of 18·75 feet diameter gives 38·50 horse power, an over-shot wheel of 17 feet 1½ inches diameter, which would be applicable to a fall of 19 feet 1½ inches, using the same amount of water, will give 35·15 horse power.

Performance by trial of the Jonval Turbine, using the same amount of water as the above mentioned over-shot wheel, with a fall of 19 feet 1½ inches, 35·81 horse power. From observations made by Mr. Tompkins, on the part of Messrs. Manning, Peckham, & Howland, (owners of both

the over-shot wheel and Jonval Turbine,) and E. Geyelin, on the night of October 30th, 1851, the movable wheel of the Jonval Turbine was found one quarter of an inch smaller in diameter than the cylinder it revolves in; consequently the wheel ought to be enlarged $\frac{3}{16}$ of an inch in diameter.

The loss of water through the excess of clearance between the movable wheel and cylinder existed on July 24, 1851, the time the above mentioned experiments were made. The circumference of the movable wheel being 10 feet, and the clearance between the wheel and cylinder, $\frac{3}{32}$ of an inch more than requisite, there was 11·25 square inches through which the water passed without producing any effect. Actual area of the openings of discharge in the wheel, 127·80 square inches: Consequently, the power to be added to the power formed by the experiment, as that due to the water escaping through the excess of clearance, will be the 11·35 part of 34·87 horse power, or 3·06 horse power.

Actual power named by trial, ...	34.81 horse power.
Additional power that can be obtained, ...	3·06 "
Total power of Turbine when properly constructed,	37·87 "

By these results it will be observed that the total power of the Jonval Turbine will be 37·87 horse power, when an overshot wheel in its best conditions will only give 35.15 horse power. *The advantage of the Jonval Turbine over the over-shot wheel, using the same amount of water, is consequently seven per cent.*

Jonval Turbine Office, Philad., Nov. 18, 1851.

For the Journal of the Franklin Institute.

On Foucault's Pendulum Experiments.

I see by an article in your number for November, that the reason of the apparent rotation of the plane of vibration of a pendulum, as shewn by Foucault's very interesting experiment, is not yet clearly seen by every body. Will you permit me to occupy a little space in your Journal, for the purpose of setting forth my own method of looking at this matter; I do not attempt any demonstration, enough of these having already been given for those familiar with mathematics, but merely to illustrate the physical reason of the phenomenon, by facts and in language familiar to all.

Imagine yourself, then, on a morning in summer standing at the foot of a plumb line and having the cardinal points of the compass marked by known objects on the horizon, watching the rising of the sun. This luminary rises to the north of east, and as he passes above the horizon, moves apparently in a path which inclines southwardly, until at length he is seen at some distance above the horizon, and due eastward from the point of observation. His motion continues towards the meridian and southwardly, until at noon he is seen due south, and from this time, his apparent path turns more and more to the north, until he is found due westward, and afterwards sets at a point north of the west point of the horizon, and if he could be perceived after this time, he would be seen moving toward the north and east, until at midnight he would be seen in

the plane of the meridian, whence he would move southward and eastward, until he again crossed the horizon and rose, at the same place as on the day before, (no allowance being made for his motion in declination.) The sun, therefore, appears to move, not simply from east to west, as we loosely express ourselves, but in an inclined path which carries him from the east by the south to the west and north. But as the sun is himself stationary, this apparent motion must be in fact attributed to the horizon, which therefore appears to move in an opposite direction from the east by the north to west and south, around the vertical line through the place of observation represented by the plumb line, at the foot of which the observer is supposed to be stationed. If now, this plumb line be made a pendulum, by starting it into vibration in any direction, say from west to east, no reason can be assigned why the plane of its vibration, (which is a purely mathematical and not a physical quantity,) should partake of this motion of the horizon. The horizon will therefore, as it were, rotate under it, or the pendulum will appear to move, as the sun does, from the east by the south to west.

This illustration is founded upon a well known fact, viz: the apparent displacement of the points of the horizon in reference to any heavenly body, in a circular direction from east by the north, around the vertical line through the place of observation. As it is a fact demonstrable by observation, it is not necessary to explain the reason of it, but if there be any one who desires its explanation, he will easily find it by reflecting that the axis of the earth, around which the motion actually takes place, is inclined (in all positions except one) to the horizontal north and south line to which, as an axis, we naturally refer this motion—and that in consequence, the plane of the motion which is perpendicular to the true axis, is necessarily oblique to that to which we refer it, whence this apparent double motion of the heavenly bodies. To an observer at the equator, the north and south line is parallel to the axis; hence the motion is perpendicular to this line, and this apparent rotation of the points of the horizon does not occur; hence also, at the equator there will be no apparent motion of the pendulum. To an observer at the pole, on the contrary, a north and south line is perpendicular to the axis, and the motion is, therefore, parallel to this axis, or the sun appears to move around the horizon without changing his distance from it, (neglecting, always, the change in declination, produced by the annual motion of the earth in its orbit.)

But it will be objected to my explanation on the part of those, who have not been able to grasp the phenomena, that the sun in the illustration, or what is the same thing, the points of the horizon in reference to the sun, go over the whole circle in twenty-four hours, in every position upon the earth's surface, while it is asserted that in reference to the pendulum, they in the same time describe an arc, less in proportion as the latitude of the place of observation is less. This difference arises from the fact that in reference to the sun or any heavenly body, the axis of the circle thus described, (which is the vertical line drawn through the point of observation,) is displaced, as is shewn by the elevation of the sun above the horizon; this increases the apparent angular motion by the displacement of the centre of the arc described; while in the case of the pendulum, which is carried along with the vertical in this movement,

no such relative displacement takes place, and the arc described by the pendulum must be less than the arc described by the sun at the same point of observation, in proportion as this displacement of the centre is greater; that is, in proportion as the latitude is less, (for the displacement is the diameter of the circle which the point of observation describes in the daily motion of the earth, which is greater at the equator, and being less as the latitude increases, disappears at the poles.)

As, therefore, this displacement disappears at the poles, the difference between the apparent motion of the sun and the pendulum will vanish, and the pedulum will describe its circle in twenty-four hours, while, as we have clearly shewn at the equator, neither the sun nor pendulum have any apparent motion in reference to the points of the horizon; and as the sun's motion is always the whole circle in 24 hours, that of the pendulum will be less in this, in a certain proportion to the latitude of the place of observation.

STUDENT.

For the Journal of the Franklin Institute.

Reply to T. Stevenson, Esq., C. E., respecting his claim to the Invention of Holophotal Apparatus for Light-Houses.

The letter of Mr. Stevenson published in the present number of this Journal, page 416, will require but a brief reply, as the members of the Franklin Institute are aware of the facts. Mr. S. evidently supposes that my invention of rings, or zones of glass, presenting in their section a curvilinear triangle, and adapted to reflecting the light in one direction, was first mentioned to the Franklin Institute, at their monthly meeting on the 20th December, 1849. The invention was not then brought forward as any novelty, having been frequently described to many of the members and others, several seasons before, by the undersigned, as is expressly mentioned in the proceedings just referred to.* The design was to discuss the various forms in which the plan might be useful, and the adaptations of which it is capable. The idea of such rings was thus rendered familiar to many, long before the date assigned by Mr. S., as the period of his publication. In fact, no merit was claimed for an idea so very obvious. It occurred to me to inquire if a ring of glass, in a fixed dioptric light, (produced by the revolution of a curvilinear triangle round a vertical axis,) projects the light in one uniform horizontal plane, or cylinder having the same axis—what would be the effect if a ring should be formed by the revolution of such a triangle round a horizontal axis? The result would necessarily be to project the incident light parallel to such axis. I presume that the same very obvious thought has occurred to many others. At what precise period this occurred to me, I do not remember. The rings I refer to are those placed in the *anterior* half of a dioptric apparatus. In relation to those invented by Mr. Stevenson, which constitute the *posterior hemisphere*, and which reflect the light to the original point of emission, and thence to the lens, I have never claimed any part of *this*, by no means obvious, but very ingenious inven-

* See also, the proceedings of the Franklin Inst. Feb. 15, 1849, and March 15, 1849.

tion, which confers great credit on Mr. Stevenson, to whom we are much indebted for it; and he will observe that I expressly described it to the meeting of the Franklin Institute, Sept. 19, 1850, (see vol. xx, 3d series of this Journal, page 236,) as his; and he, I am happy to be informed, has additional merit in carrying it into actual practice. G. W. Smith.

Translated for the Journal of the Franklin Institute.

Physics.—Upon the hypotheses relative to Luminous Ether, and upon an experiment which seems to demonstrate that the motion of Bodies changes the velocity with which light is propagated within them. By M. H. Fizeau. (*Extract by the Author.*)

Numerous theories have been proposed to account for the phenomenon of aberration on the system of undulations. Fresnel, in the first place, and more recently Messrs. Doppler, Stokes, Challis, and several others, have published important articles on this subject; but it appears that none of these theories have received the entire assent of natural philosophers. Indeed, in the absence of certain knowledge of the properties of luminous ether, and of its relations to ponderable matter, it has been found necessary to make hypotheses, and amongst those which have been proposed, there are several more or less probable, but none which may be considered as proved.

These hypotheses may be reduced to three principal ones. They have reference to the condition in which the ether existing in the interior of a transparent body is to be conceived.

Either the ether is adherent, and as it were, attached to the molecules of a body and consequently partakes of the motion which may be given to that body:

Or, the ether is free, independent, and is not carried along by the body in its movements:

Or, finally, by a third hypothesis, which partakes of the other two, a portion only of the ether is free, the other portion is fixed to the molecules of the body, and that alone moves within it.

This last hypothesis, which we owe to Fresnel, was started with the view of accounting at the same time for the phenomenon of aberrations, and a celebrated experiment of Mr. Arago, by which it is shown, that the motion of the earth is without influence upon the refraction which the light of the stars undergoes in a prism.

We can examine the value, which, for each of these hypotheses, is to be given to the velocity of light in bodies, when we suppose those bodies in motion. The value of these velocities may be changed by the fact of the motion.

If we suppose that all the ether is carried along with the body, the velocity of the light will be augmented by the entire velocity of the body, supposing the ray to be projected in the direction of the motion. If the ether is supposed to be free, the velocity of the light will not be changed.

Finally, if only a portion of the ether is carried along, the velocity of the light will be augmented, but by a fraction only of the velocity of

the body, and not by the totality, as in the first hypothesis. This consequence is not as evident as the preceding ones, but Fresnel has shown that it may be supported by very probable mechanical considerations.

Although the velocity of light is so enormous in comparison with the velocities which we are able to give to bodies, yet we possess, at the present day, means of observation so delicate, that it has been thought possible to determine by a direct experiment, what is really the influence of the motion of bodies on the velocity of light.

We owe to Mr. Arago a method founded on the phenomenon of interferences, which is capable of indicating the smallest variation in the indices of the refraction of bodies. The observations of Messrs. Arago and Fresnel, upon the difference of refraction which exists between dry and moist air, have shown the extraordinary sensibility of this means of observation.

It is by adopting the same principle, and joining the double tube of Mr. Arago to the apparatus of two conjugate telescopes which I had employed for the determination of the absolute velocity of light, that I have been enabled to study directly in two mediums, air and water, the effects of the motion of a body on the light which traverses it.

I shall endeavor to point out, without the aid of a drawing, what was the course of the light in this experiment. From the focus of a cylindrical lens, the solar rays entered almost immediately the first telescope by a lateral opening near its focus—a transparent mirror, whose surface was at an angle of 45° to the axis of the telescope, threw them by reflection, in the direction of the object glass.

After passing out from the object glass, the rays, having become parallel to each other, arrived at a double slit, each opening of which corresponded with the entrance of one of the tubes. Thus a very narrow pencil of rays penetrated into each tube and traversed its whole length. (1·487m. = 4ft. 10in.)

The two pencils of light, still parallel to each other, reached the object glass of the second telescope, were refracted, and by the effect of that refraction united at its focus; there they encountered the surface of a mirror perpendicular to the axis of the telescope, and underwent a reflection, which returned them towards the object glass. But, by the effect of the reflection, the pencils had changed their route, so that that which was before to the right passed to the left after the reflection, and vice versa. After having again traversed the object glass, and thus become once more parallel to each other, they entered a second time the tubes; but as they were inverted, that which had passed through one of the tubes in going, passed through the other tube on its return.

After their second passage through the tubes, the two beams again traversed the double slit, re-entered the first telescope, and, passing through the transparent glass, interfered at its focus. There they formed, by their mutual action, fringes of interference, which were observed with an eyepiece provided with a scale of divisions at its focus.

It was necessary that the fringes should be very wide for the purpose of permitting the appreciation of small fractions of the width of a fringe. I found that this result was obtained, whilst still preserving a great intensity of light, by placing before one of the slits a thick glass, inclined in such a manner as to show the two slits by the effect of refrac-

tion, as though they were nearer to each other than they were in reality; one may thus give to the fringes variable dimensions, and choose that which is most suitable for the observations. The double passage of the light has for its object, the increase of the distance passed over within the medium in motion, and, moreover, to compensate entirely for the influence of an accidental difference of temperature, or of pressure in the two tubes, whence might result a displacement of the fringes that would be confounded with the displacement which the motion might produce, and would render the observation uncertain.

Indeed, it is very easy to see that, by this arrangement, each point, situated on the path of one of the pencils, is equally on the path of the other, so that a change in the density at any point whatever in the passage acts in the same manner on the two rays, and can not consequently have any influence upon the position of the fringes. The fact that the compensation is total, was verified by placing a thick glass before one only of the two slits, or indeed by filling with water one only of the tubes, the other being filled with air. Neither of these experiments caused the slightest change in the position of the fringes. Relative to the motion, we see, on the contrary, that the two beams are submitted to opposite influences.

If we suppose, in fact, that in the tube placed on the right the water flows towards the observer, the beam coming from the right will have passed through the tube in the direction of the motion, whereas the beam coming from the left will have passed through it in a direction contrary to the motion.

By making the water in the two tubes flow, at the same time, in directions opposed to each other, we perceive that the effects should be added. This double current being produced, we may reverse the direction, at the same time, in each tube, and the effect should again be doubled.

All these movements of the water were produced in a very simple manner, each tube being in communication by means of two branches placed near its extremities, with two glass reservoirs, on which pressure was alternately exercised by means of compressed air. Under this pressure the water passed from one reservoir to the other through the tube whose two extremities were closed by glasses. The interior diameter of the tubes was 5·3 m. (2·087 inches,) their length 1·487 m. (4 feet 10 inches;) they were of glass.

The pressure under which the flow of the water took place was perhaps more than two atmospheres. The velocity was calculated by dividing the volume of water passed over in one second by the area of the section of the tube. I should say for the purpose of anticipating an objection which might be made, that the greatest care was taken to avoid the effects of accidental movements which the pressure and shock of the water might have produced. Thus the two tubes and the reservoir, where the motion of the water took place, rested on supports independent of the other portions of the apparatus, and particularly of the two telescopes, and it was therefore the tubes only which could receive an accidental movement; but both reason and experience have shown, that the movements or bending of the tubes alone were without influence on the position of the fringes. The result of the observations made, is as follows:

When the water is set in motion its fringes are displaced, and according to the direction in which the water moves, the displacement takes place to the right or to the left.

The fringes are displaced towards the right, when the water flows from the observer in the tube situated on his right, and towards the observer in the tube situated on his left.

The fringes are displaced towards the left, when the direction of the current in each tube is opposite to that just indicated.

With a velocity of the water equal to two metres per second, the displacement is already very perceptible; with velocities of from four to seven metres, it becomes perfectly susceptible of being measured after having verified the existence of the phenomenon. I endeavored to ascertain its numerical value with as much exactitude as was possible, calling, a *simple* displacement, that which is produced when the water previously in repose was just set in motion, and a *double* displacement, that which is produced when the motion has just been changed to a contrary motion. We find by a mean deduced from nineteen observations, differing but slightly from each other, 0·23 for a simple displacement, which gives 0·46 for a double displacement, the width of the fringe being taken for unity. The velocity of the water was 7·069m. per second.

This result is afterwards compared with those which are deduced by calculation from the divers hypotheses relative to the ether.

On the supposition that the ether exists free, and independent of the motion of bodies, the displacement should be nothing.

On the hypothesis that the ether is united to the molecules of bodies, so as to partake of their motion, the calculation gives for the double displacement, the value of 0·92. The observation gave a number one-half smaller, or 0·46.

On the hypothesis that the ether is partially carried along, according to the theory of Fresnel, the calculation gives 0·40, that is to say, a number very approximately that which has been found by observation. And the difference between these two values would have been very probably still less, had it been found possible to introduce into the calculation of the velocity of the water, a correction necessarily neglected for want of data sufficiently precise, and depending on the unequal velocity of the different liquid filaments: in estimating the value of this correction in the most probable manner, we see that it tends to augment a little the theoretic number, and to approximate still more its value to the result of the observation.

An experiment similar to that just reported, had been previously made with air in motion, and I had ascertained *that the motion of the air produces no sensible displacement in the fringes*. Under the circumstances in which this experiment was made, and with the velocity of 25 metres per second, which was that given to the motion of the air, we find in the hypothesis, that the ether was carried along, that the double displacement should have been 0·82.

According to the hypothesis of Fresnel, the same displacement should have been but 0·000465, that is to say, altogether insensible. Thus the apparent immobility of the fringes, with the air in motion, is altogether in accordance with the theory of Fresnel.

It was after having verified this negative fact, and in the endeavor to explain the divers hypotheses relative to ether, in such a manner as to make them accord at the same time with the phenomenon of aberration, and with the experiment of M. Arago, that it appeared to me necessary to admit with Fresnel, that the motion of bodies occasions a change in the velocity of light, and that this change of velocity is greater or less for different mediums, according to the energy with which these mediums refract light, so that it is considerable in bodies of great refractive power, and very feeble in those which refract less, as the air.

It results from this, that if the fringes were not displaced when the light traversed air in motion, we should on the contrary have a very sensible displacement, in making the experiment with water whose index of refraction is much greater than that of air.

An experiment, for which we are indebted to M. Babinet, published in the IX. volume of the *Comptes Rendus de l'Academie des Sciences*, appeared to be in contradiction with the change of velocity in conformity with the law of Fresnel. But in considering the circumstances of this experiment, I have remarked the existence of a cause of compensation which should render insensible the effect due to the motion; this cause arises from the reflection which the light undergoes in this experiment; in fact, we can demonstrate, that when two rays have relative to each other a certain difference of phase, this difference is altered by the effect of the reflection from a mirror in motion; now in calculating separately the two effects in the experiment of M. Babinet, we find that they have values sensibly equal, and contrary signs.

This explanation renders still more probable the hypothesis of the change of velocity, and an experiment made in water in motion appears to me proper in every respect to decide the question with certainty.

The success of this experiment seems to me to necessitate the adoption of the hypothesis of Fresnel, or at least of the law which he has discovered to express the change of the velocity of light by the effect of the motion of bodies; for although, should this law be found true, it would be very strong proof in favor of the hypothesis of which it is but a consequence, perhaps the conception of Fresnel will appear so extraordinary, and in some respects so difficult to admit, that still further proofs, and a profound examination on the part of mathematicians may be demanded before adopting it as the expression of the reality of things.

For the Journal of the Franklin Institute.

Exposition of Foucault's Experiment. *By* J. S. Brown.

In the exposition of Foucault's experiment, on page 354 of the Journal, an error was inadvertently inserted. It was there said that the deviation of the pendulum between 45° and 90° "is slower in the first, and faster in the last part of each half revolution." It should have read, slower in the first part of the first, and last part of the last, and faster in the last part of the first, and first part of the last half revolution.

I will here add, that between 0° and 45°, the deviation of the pendulum in the last half of each revolution of the earth is first *against the sun*,

and then back, the reverse of its movements in the first half of the revolution. But this would be readily inferred without special notice.

The exemplifications given in my first communication were all on the supposition that the pendulum should commence oscillating in the meridional plane. The same phenomena would be exhibited if the original plane of oscillation should be in any other point of the compass, as is readily perceived by considering that the same conditions continue, with the simple variation of the original direction of the generating planes in the sphere, while their relative directions remain the same. The angles which the tangents of the great circles, in which the two generating planes cut the earth, make with the respective axes of those planes, are the variables dependent on the direction of the original plane of oscillation. And these angles are invariably the same with both generating planes, whatever their original direction. When the original direction is north and south, these angles are nothing; when east and west, 90°, as the direction varies from the meridional.

The slight irregularity arising from the spheroidity of the earth, or any other incidental disturbance, was not there considered, being foreign from the object proposed in the exposition.

Washington, D. C., Nov. 25, 1851.

Description of a New Chain, invented by M. Sisco.*

Experiments have been made at Woolwich Dockyard with a new description of chains, submitted by M. Sisco, a Frenchman. The new chains are made of common hoop-iron of the breadth required, and wound on a reel by machinery into an oval shape, and to the same breadth as the outer surface, which is rounded off after the whole has been brazed in passing through a furnace of molten metal. The usual test of an iron chain for naval service of two inches in diameter is 70 tons strain, but many links break with the application of far less power, and yet the other parts of the chain are found qualified to pass the required ordeal. M. Sisco's chain of two inches broad and two inches thick, with stays in the centre of each of the two links, was placed in the testing-frame, attached to a testing-chain of $2\frac{1}{2}$ inches in diameter, and on the hydraulic power being applied one of the links was lengthened $\frac{5}{8}$-inch and the other $\frac{1}{3}$-inch when it reached a strain of 110 tons, and the $2\frac{1}{2}$-inch testing-chain broke off in two places when the strain reached 114 tons. The hoop-iron chain had some openings in one of the links, which had been imperfectly brazed, but it did not appear to have been otherwise defective. One link of the same dimensions, 2 inches thick and 2 inches broad, was afterwards placed in the testing-frame, and when a strain of 70 tons was applied to it had lengthened $\frac{1}{32}$-inch; with 80 tons, $\frac{1}{8}$-inch; with 100 tons, $\frac{3}{16}$-inch; with 110 tons, $\frac{1}{4}$-inch; with 115 tons, $\frac{5}{16}$-inch; and when it resisted 120 tons strain it was considered advisable not to continue the strain, as it was so great as to loosen the stone frame on which the machine rested, and liable to damage other parts of the powerful frame of the machine. The strain applied on this occasion was one ton more than had ever been previously

* From the London Architect for November, 1851.

applied, and the hoop-chain was only slightly opened on one side. When inquiries were made as to the price at which the hoop chains could be supplied, it was stated that they would not cost more per cwt. than the common chains, although their holding powers were so much greater in proportion.

On the Passage of the Steamer Atlantic from New York to Liverpool. By JOHN HAMPSON, C. E.*

The following account of the number of revolutions made by the engines of the United States Mail Steamer *Atlantic*, on her August trip, from New York to Liverpool, and calculation of the slip of the wheels, may be acceptable to your readers.

Whole number of revolutions reported by the engineer,	217,681
Distance from port to port,	3050 miles.
Effective diameter of wheels, reckoning from centre to centre of float, floats 27 inches deep,	33·33 feet.
Hence $\frac{33{\cdot}33 \times 3{\cdot}141 \times 217{,}681}{6116}$ = . . .	3728·26 miles.
Distance presumed to have been run (at the least,)	3050
Miles slip	678·26

equal to $18\frac{18}{100}$ per cent.

London, Sept. 29, 1851.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, November 20, 1851.

S. V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

A. S. Roberts, Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

Donations were received from The Chemical Society, London; B. H. Latrobe, Esq., Baltimore, Maryland; Thos. Ewbank, Esq., and Gen. T. Lawson, Surgeon Gen. U. S. Army, Washington, D. C.; J. R. Tyson, H. C. Baird, Blanchard & Lea, John F. Frazer, Horatio Stephens, Wm. Firmstone, and Edward Miller, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of October was read.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented their report on the late Exhibition.

Resignations of membership in the Institute (53) were read and accepted.

* From the London Artizan for October, 1851.

New candidates for membership in the Institute (97) were proposed, and the candidates (32) proposed at the last meeting were duly elected.

On motion, the following awards were made in accordance with the Report of the Committee on Exhibitions, presented this evening:

To Messrs. Cornelius & Co., of Philadelphia, *The Franklin Gold Medal*, for the novelty and beauty of the designs, and for excellence of workmanship in chandaliers, brackets, and candelabras, shown at the late exhibition.

To Messrs. Lammot & Son, of Delaware County, Pa., the usual *Gold Medal*, for the very superior quality of bed tickings, shown by them.

To Messrs. Griswold & Co., of Troy, New York, the usual *Gold Medal*, for Velvet and Tapestry Carpeting, which the judges say are equal to the best foreign productions, and superior to any domestic of the same character that have come under their notice.

Dr. Rand exhibited several specimens of crystalized slags, which were presented to the Institute by Mr. Horatio Stephens, of the Allentown Iron Works; they consisted of silicates of lime, &c., and were of the form of cubes, prisms, &c., very perfect and of great beauty.

Prof. J. C. Cresson also presented to the notice of the Institute, a specimen of crystalized pig iron of white color, but of great purity, from Cooper & Co's. Furnace, New Jersey; presented to the Cabinet of the Institute by Mr. Wm. Firmstone.

Self-acting Railroad Switch, by Mr. W. Foster, of Trenton, was brought before the meeting, and a model exhibited by his son, and its action explained.

G. W. Smith called the attention of the members to two beautiful designs for carpets; one of a lion excited general admiration by its elegance, and the great beauty of finish and coloring of the eye and other details. They were of English manufacture, and the under surface was of gum elastic. Prof. Cresson made some interesting remarks in regard to the history of this form of carpet, and explained the great care in preparing the colors, so that compressions may be employed. Mr. Smith observed that the only objection to their use was, the exclusion of air from the surface of the floor, so as to cause it to rot.

Mr. Smith called the attention of the Institute to the destructive effects of anthracite vapor on the mortar, and even the action on the bricks so as to destroy them, producing a very dangerous condition of the chimneys of our residences. He attributed the effect to the sulphurous acid (which results from the combustion of nearly every species of coal) forming sulphuric acid in the pores of the bricks and mortar, and also to the hydrochloric acid and the ammonia. A chimney of J. P. Wetherill, Esq's. had been efficiently protected by a coating of wax, and Mr. S. thought a coat of tar might be used. Dr. Wynne inquired of Mr. Smith, if the same results were produced by semi-bituminous coal, when Mr. Smith referred him to Isaac Lea, Esq., who remarked that it arose from the sulphurous acid generated, and which was produced by all the varieties of coal containing sulphur. Mr. Lea suggested the use of a handsome clay cap, well burned, which he had seen in a recent visit to Cincinnati.

Prof. Cresson found from close observation, that previous to rain, the streaks of white matter on the surface of the bricks, were nitrate of lime produced by the decomposition of the mortar. Prof. Frazer suggested

the use of glazed bricks, with the proper kind of mortar, or those well burned chimney tops of Mr. Harrison, which were exhibited during the last display of our Institute.

Dr. Rand thought that the result might also be produced by the use of wood in air-tight stoves, now so extensively used, by the generation of pyroligneous acid.

Dr. Turnbull observed that there were two important agents which had not been brought forward, namely, the use by builders, of sand and gravel containing a large quantity of alumina, obtained from sand and gravel pits in the neighborhood of our city, the sulphurous acid coming in contact with alumina in the mortar, and forming a sulphate of alumina which is washed out of impure and improperly made mortar, and thus loosening the brick. The true remedy was to obtain well washed sand and gravel, and make a proper mortar, so as to hold the bricks firm, for builders find that it requires more hydrate of lime to make a proper mortar with good sand. Another evil was the large quantity of nitric oxide, and when in air, nitrous acid, which combining with even the very best mortar, forms nitrate of lime, and every shower washes it down, and thereby destroys the cement which unites the bricks.

Prof. J. C. Cresson explained to the meeting, the great difficulty experienced at the Philadelphia Gas Works from the spontaneous combustion of large quantities of the bituminous coals from Virginia, which contain iron pyrites, the first notice of which was the slow distillation of benzole, and after a time it burst out into a flame, so that there would be a space of 50 feet in flames at one time. He had constructed an apparatus, by which he could force any amount of carbonic acid into it from a pipe eight inches in diameter, so as to fill the whole space with it, but although the flame was extinguished for the time, it would again break out, with as much force as ever, and burn even with more rapidity. They ad also employed large trunks, so that the air could be sent throughout the whole mass, but they had experienced no advantage from this arrangement, and when the fire had commenced to burn, it most generally continued with more violence near the trunks which conducted the air.

There was, therefore, no resort but to flood the whole mass of coal, and thereby damage a considerable quantity of it, rendering it unfit for the purposes of gas making.

Mr. Youmans exhibited a well designed chemical chart, and explained it to the meeting. He stated that nearly all the natural sciences could be taught to children at school; and why could we not teach chemistry? He also stated that by the use of a certain number of the elements painted in colors, with lines connecting the most important compounds and diagrams of the sign, and as near as possible the color of the body, or the color of the salts. Children could learn enough of chemistry to make it an object for teachers to introduce it even into the ordinary school course.

Mr. I. Lea in some elegant remarks gave a short biographical sketch of the life and writings of our deceased fellow member, Richard C. Taylor, Esq., one of the most accurate geologists who has ever examined the extensive coal fields of Pennsylvania, and who has written a book which contains more information on the subject of coal, than any other work in the English language. In his youth he was thoroughly educated, in the art of mining, both practically and theoretically, which fitted him for the

study of geology, so that an opinion from him was of great value. He was born in England, but for the latter part of his life, was a resident of Philadelphia, and had gone completely over, and surveyed the entire coal fields of our state.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on the Explosion of a Steam Boiler at I. P. Morris & Co.'s Factory.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, to whom was referred for examination, the "Explosion of a Steam Boiler," at the Factory of Messrs I. P. Morris & Co., at Richmond, Philadelphia County, Penna.—REPORT:—

That the boiler in question was of a cylindrical form, 5 feet in diameter and 16 feet long, having a fire-box at one end, from which three main flues, the largest of which was 20 inches in diameter, extended to the smoke-box, from which twelve return flues, 6 inches in diameter, carried the products of combustion to the chimney. Near the end of the boiler there was a steam dome 4 feet in diameter, which was placed over an opening of the same size in the shell of the boiler. The iron of which the boiler was made, was of the best quality, 0·3 inches in thickness. This boiler was intended for the use of a steamboat, and was to be used under 100 lbs. pressure. The parties who ordered it required that it should first be tested under a pressure of 150 lbs. Upon this trial the fire was kept up, until the safety-valve lifted under a pressure of 148 lbs; an additional weight was then added sufficient to give the requisite pressure of 150 lbs, and after a few moments, the experiment was considered as satisfactory, and directions were given to open the fire-doors; at this moment the explosion took place, killing one of the persons present, and severely injuring two others, one of whom has since died.

The boiler was torn into at least three pieces, by fractures perpendicular to the axis,—one of which, (the fire-box end,) was thrown forward, and came in contact with two large Cornish boilers which were lying in front of it, indicating by its effects upon them the terrific violence with which it had been projected. The waist of the boiler was torn from the steam dome, ripped open, and flattened out upon the wharf where it lay, while the steam dome and other portions, were thrown high into the air, and fell into the Delaware river, whence they have not been recovered. The main flue was also separated from the rest and thrown into the dock, whence it was afterwards recovered and found flattened, but apparently not collapsed by the pressure of the steam.

In seeking to account for this explosion, we may in the first place remark, that there appears no reason whatever, to suspect the existence of a low water-level. The experiment had been but a short time in progress, no water or steam had been lost, except that which was blown off at the safety-valve, nor was any pump in connexion with the boiler by which cold water might be thrown upon an exposed and overheated surface. This, then, the most common of all causes of explosion of steam boilers, cannot be reverted to, to explain this one.

Nor is there any reason to suspect carelessness or recklessness on the part of those in charge of the experiment, nor negligence or mistake in

the calculation of the pressure on the safety-valve. The boiler was at the time under the charge of perfectly competent persons, who were under no excitement, had no inducement to rashness, nor were under circumstances likely to lead to overhaste, and whose lives were, as the result too sadly proved, exposed in the event of an explosion.

The committee submitted to the proof of the breaking apparatus, pieces of the iron taken from the edges of the fractures, and the results shewed that the iron was of good quality. The following are the breaking weights per square inch of section, of these pieces:

Iron taken from the side of the boiler;				with the fibre,	67·200 lbs;	across the fibre,	67·200 lbs.
"	"	shell	"	"	50·400	"	56·000 "
"	"	flues	"	"	53·760	"	54·880 "

If from these data, and the diameter and thickness of the shell of the boiler, we calculate its strength, and compare it with the effort exerted upon the shell by a pressure of 150 lbs. per square inch, we shall find that after making all possible allowances, a simple cylindrical shell of such diameter and thickness, and made of such materials, would have been fully equal to the strain brought upon it. But when we consider the effect of the large opening made into the steam dome, we shall see that the strength of the cylinder was very materially diminished, and probably brought below what was necessary to resist the strain upon it.

It will be easily seen that the effect of such an opening thus covered must be to bring a greatly increased strain upon its edge where it intersects the upper line of the shell, while the dome itself gives but little aid in resisting this pressure, and if the deformation of the shape or a tear of the iron should be the consequence, the other results of the explosion might easily follow. The committee deem this defect of form to be so manifestly sufficient to account for the explosion that they do not think it necessary to advert to any other, but strongly call the attention of boiler builders and engineers to the importance of avoiding such large openings in the shell in future.

In conclusion, they take this opportunity of returning their thanks to I. P. Morris & Co., for the facilities which they so freely afforded them for a thorough examination.

By order of the Committee.

WILLIAM HAMILTON, *Actuary.*

Philadelphia, Nov. 13, 1851.

BIBLIOGRAPHICAL NOTICE.

Medical Lexicon.—A Dictionary of Medical Science; by ROBLEY DUNGLISON, M. D. *8th Edition. Revised and greatly enlarged.* Philadelphia: Blanchard & Lea, 1851.

In acknowledging the reception of, and in directing attention to, this elaborate Medical Dictionary, we can only reiterate the general voice of the profession, for which it is especially intended, in proclaiming it to be the most extensive and useful work of the kind ever published in this country.

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